Telephone Engineer

WITH WHICH IS CONSOLIDATED THE WESTERN TELEPHONE JOURNAL
ESTABLISHED 1902

VOL. X | CHICAGO, AUGUST, 1913 | No. 2

PUBLISHED MONTHLY BY THE
ELECTRICITY MAGAZINE CORPORATION
Monadnock Building, Chicago.

Ed J. Mock and Paul H. Woodruff, Editors.
TELEPHONES: HARRISON 3014—AUTOMATIC 61028.

LONDON OFFICE.....36 Maiden Lane, Covent Garden
S. RENTELL & Co., Representatives.

Entered as second-class matter May 26, 1909, at the postoffice at Chicago, Illinois, under Act of March 3, 1879.

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico.....Per year, $2.00
Canada.....Per year, 2.50
Foreign countries within the Postal Union.....Per year, 3.00
Single Copy..... .20

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COMPETITION IN CHICAGO.

CHICAGO'S long and patient encouragement of competitive telephony, her attempts to build up a dual service, have apparently come to naught. To the city council of Chicago, the local independent automatic system, operating as the Illinois Telephone and Telegraph Company, has signified its desire to sell out to the Chicago Telephone Company, which, in turn, has confessed an anxiety to take over the property. There remains but to obtain the consent of the city officials to the transfer. This necessary approval is withheld at the present time, but the matter will be settled when the aldermen resume their deliberations after the summer vacation.

This consolidation will mean that the Chicago Telephone Company must pay interest on six million dollars more. If the Chicago independent has 30,000 telephones in service, this figure capitalizes them at $200 apiece—a high figure even if there were no duplication and the Bell Company actually increased its directory by the full number. As a matter of fact, the duplication percentage in Chicago is large—much larger than in most cases of dual service. The Chicago Telephone Company had developed its territory to a high degree before the advent of the independent; and the latter, because of the utilization of its tunnel system, has confined its operations to the business district already well supplied. What the Chicago Telephone Company actually gains beyond relief from a more or less harrassing competition is not wholly apparent to the outsider, and must be left to the company's accountants. Evidently it is confident of its ability so to incorporate the new property that future rates will take care of the obligation. On this basis Chicago's second system will amount to more, as a going concern, in captivity than it ever did at large.

But there is at least one reason why the Chicago deal may find obstacles ahead of it. In the original ordinance of the Illinois Telephone and Telegraph, or rather its predecessor, the Illinois Tunnel Company, is the following clause:

It shall be expressly the condition of this grant that if the Illinois Tunnel Company or any of its successors or assigns, shall either sell out to or *enter into any agreement with any existing telephone company,* or any of its successors or assigns, doing business in the city of Chicago, which agreement should tend to make competition inoperative, this ordinance shall become null and void, and the plant of said company, together with the conduits, wires and poles then in the streets belonging to said company shall be forfeited to the city.

It is generally contended, and with some justice, that economic law is back of the single telephone system. Newspaper comment on dual service, however, never refers to it as commercial extravagance, which it is, but speaks of the "two-telephone nuisance"—which it is not.

Ever since the independent telephone established itself in Chicago there has been one in the office of TELE-

PHONE ENGINEER. We use the Bell instrument more, because it is connected with more parties that we want. We used the independent whenever we could, because it gave us better service than we have been getting lately on the other line. The ringer gongs on the two lines were distinctive, and we never confused their signals. The two bills totaled about what the same service would cost on a single system—an economic impossibility according to experts, but still a fact.

In short, we never found dual service the nuisance it is generally reported, and its un-economy, so obvious in the white light of logic, has not yet become obtrusive in our brief experience with it. Candidly, and in a purely personal sense, we shall be rather sorry to lose the second system.

Aside from all economic aspects of any consolidation of two systems, the absorption of an independent telephone company frequently has one unfortunate result. It casts the imputation of disloyalty to the independent cause upon men who have nothing to do with and no control over the sale. That is as true today as it was ten years ago, when men were read out of the independents in disgrace because not they, but their stockholders, sold out.

Some of the officers of the Telephone Service Association, which is purely and emphatically independent, are also prominent in the management of the Illinois Telephone and Telegraph Company, which is now, it seems, entirely Bell. The intelligent observer knows not only that the Service Association has nothing to do with the telephone company, but that the association officers connected with the company had nothing to do with its sale. Both they and their association are as independent as ever.

Chicago's present officials appear to favor telephone competition. If the independents could but muster some of the old time spirit, there might still be an opportunity for a second system in the Windy City.

THE PACIFIC COAST SUIT.

JUST three months ago Attorney-General McReynolds decided that the case of the American Telephone and Telegraph Company should be referred to the Interstate Commerce Commission. In so deciding, however, it is apparent that the attorney-general did not wash his hands of the entire matter, since on July 24 he brought suit at Portland, Ore., against the American Telephone and Telegraph Company under the anti-trust law. The government charges the company and its subsidiaries with absorbing independent telephone companies to destroy competition and create a monopoly in Oregon, Washington, Montana and Idaho.

Mr. McReynolds asks the court to compel the Bell companies to relinquish control of the Independent Telephone Company of Seattle, the Home Telephone Company of Puget Sound, the Northwestern Long Distance Telephone Company, the Interstate Consolidated Telephone Company and the Independent Long Distance Telephone Company. If necessary to accomplish the dissolution the court is asked to appoint a receiver for the properties. The court is also requested to require the alleged trust to dispose of the stocks, bonds and physical properties of the independents "to persons not connected with the Bell companies as stockholders or otherwise." An immediate restraining order is asked to prevent any further steps in pending foreclosure suits to transfer the physical properties of the Northwestern Long Distance Telephone Company to the Bell companies. The latter by reducing rates, by giving free service and by threats, it is alleged, have forced several independent companies forming links in the long distance system to violate their contracts for connections with the Northwestern company and to give their business exclusively to the Bell concerns.

"This proceeding," says Mr. McReynolds, "is brought to correct an exceptional condition and will not in any way interfere with the broad investigation of telephone conditions throughout the entire country undertaken by the Interstate Commerce Commission."

This case will be virtually a trial to determine the legitimacy of the public utility claim to natural monopoly. But even if, in the court's opinion, the telephone is naturally monopolistic, there is still to be decided what liberties an operating telephone company may take with a competitor. Natural monopoly in a broad sense can never mean more than that a single service may be enough for a single community. It does not necessarily mean that a single service will be always satisfactory to two communities, or to all communities.

Where two companies serve the same territory, one must always be better than the other, and the best service must win ultimately. That is legitimate elimination of competition. Whether or not it is the only legitimate method, or whether all the usual tactics of competitive warfare, ending in the absorption of the rival company, may be allowed will doubtless be decided by this case.

PITFALLS OF STATE OWNERSHIP.

TELEPHONE men of the United States are inclined to smile at the suggestion of any possibility of government ownership in this country. The smile is probably justified, for there is little likelihood that our government will undertake to operate a national system of telephones in the day of present operators. But it must be recognized that commission regulation, however excellent, has, and will continue to have, the effect of turning the covetous eye of the politician on the telephone business. A very good proportion of the public knows nothing of the economics of state versus private ownership, and without experience in the former would be inclined to favor it—as an interesting experiment at least. Most public utility operators suspect that, in a popular vote, state ownership would have more than a fighting chance, through sheer ignorance on the part of the voters.

Of all foreign governments we regard that of Great Britain as most comparable with our own. For many years that country enjoyed, under private ownership, a telephone development which, though not equal to that of the United States, was quite satisfactory. Nineteen months ago this system was taken over by the British postoffice, and is now being operated in the most approved government style.

In the light of the fact that British politics is in some respects more earnest and less selfish than our own, and that the British government might fairly be ex-

pected to operate a utility as efficiently as any government, the following editorial comments by the London *Electrical Review* are particularly striking:

The British public, having now possessed its very own telephone service for some 18 months, is awakening. It has dawned upon the intelligence of John Bull that perhaps, after all, national ownership is "not all that it's cracked up to be," and that expert management in the hands of a highly developed commercial and technical staff is not so detrimental to the public welfare as he has been told. Indeed, we fancy he would gladly find himself once more within the greedy clutches of the devouring telephone trust, which he has just recently succeeded in parting from its ill-gotten gains under conditions which, if suffered by himself, he would have characterized as extremely unfair.

Last week the growing popular irritation was voiced by the London Chamber of Commerce, which sent a deputation to interview the postmaster-general on the subject of the injustice of the contracts with subscribers and the inefficiency of the service. Mr. Samuel admitted that the service was not all that could be desired—an admirably diplomatic way of putting the best face on the matter. He also detailed the sums of money that he was spending and would spend on the system, and expressed most praiseworthy views regarding the importance of efficiency rather than cheapness; but kind words butter no parsnips, and, much as we respect and admire Mr. Samuel, who has done his best and deserved well of the country, we cannot accept his soft answers as compensation for the deficiencies of the telephone service.

In London alone, he said, there were one million calls a day—and this he gave with charming inconsequence as a reason why subscribers should accept without question the post office record of the number of their calls! He proceeded to say that the number of calls that were ineffective, owing to the lack of sufficient junction lines, was extremely small—less than ½ per cent. But ½ per cent on a million is no less than 5,000 calls a day wasted through this cause alone, to say nothing of the others—is not this a serious matter?

In this connection the attitude of the telephone department towards the immense problem with which it is confronted is put in a remarkable light by the statements of one of the secretaries of that department who visited Nottingham last week, to hear the complaints of the corporation and the local chamber of commerce. These statements were published in the *Evening Standard* of June 30th, in which we read that the secretary admitted that complaints were being made on all hands by subscribers. "The service is not what we would like," he confessed; "the telephone system is a worrying business." Oh, for peace and a quiet life! "There are places in London where we do not want any more subscribers, for it would be impossible to give them a good service. . . . People in the West End are continually writing to the postmaster-general asking for lines, but they are told that they cannot get them, and this is just what they cannot understand." The naïveté of these remarks is delicious. "There are places"—is there any place in London where the existing subscribers get a good service? According to a further statement of this candid secretary, until the end of the year the post office can take no more subscribers at Victoria. It may be inferred that the post office is not in the telephone business with a view to developing it, but merely to keep things going—to maintain the status quo, that fetish of politicians which is born of ignorance and timidity: ignorance regarding the business in hand, and fear of the consequences of a bold forward step. Why will not those West End people be quiet and cease from troubling ? Ears have they, says the post office, and they do not understand—that they cannot have telephones too. Dolts!

Proceeding, the secretary, with a nerve which commands admiration, if not respect, says that the lack of sufficient provision for future business "was the fault of the National Company." "When the post office took up the telephones in 1902, we did not provide for service for the whole of London, expecting that the National Company would have made ample provision by the time the transfer came into force."

We are at a loss to comment on this remark. As the bargee said in a similar strait, "There ain't no words for it." It appears from further remarks that the post office offered to do it and lend the new plant to the company, but the latter most naturally declined, pointing out the obvious fact that if this were done, the post office would refuse to buy the company's old plant when the transfer came. "Ultimately we built an Avenue exchange, and for some time the result of transferring was a ghastly business. For a few weeks there was a very bad time for the Avenue subscribers." Yes; but why say "for a few weeks"? "We have increased the staff of operators . . . . for the moment this seems to be no advantage." The post office appears surprised to find that under state management a larger staff is required to do the same work. Every one else knew that years ago, and said it.

"The truth" (there is quite a lot of truth in this secretary's statements "is that at present we are not anxious to advertise the telephones." No need—the subscribers are doing that efficiently.

"We hope that in five years' time we shall have as good a system as that in New York, and we believe that *already we have as good a system as that in Paris.*"

This is a fitting climax to this astounding series of disclosures. It is notorious in telephone circles that the state service in Paris is the last word in inefficiency and mismanagement; the subscribers had to form an association to fight the government and compel reform.

What do we learn from the foregoing extracts? Is it not that the post office entered upon this gigantic undertaking without appreciating the necessities of the case? Without due preparation, without co-operation with the company on a reasonable basis, without adequate staff, without the necessary funds? The department has shown a deplorable lack of foresight and incapacity for handling the tremendous problem which is so lightheartedly took up.

We do not for a moment blame the engineering staff of the post office, for the members of which we have sincere respect and cordial sympathy. The fundamental canker is the lack of co-ordination of the administrative and technical staffs, to which we drew attention some years ago, and which results in constant friction and waste of effort. Under the National Telephone Company the management of the system was in the hands of a machine organized upon a sound commercial basis, by which the highest technical skill and the best business ability were combined and utilized with the utmost efficiency and perfect harmony. The post office in taking over the undertaking rejected the best men. Cannot our bureaucrats realize that the best is the cheapest in the end? That a good man is worth a high salary, and can command his own price?

But it is useless to protest; the defects of state control are inherent to the system, and the teachings of history are lost upon the politician, who, of all men, ought to make them his special study. As in England, so it is in France and in Germany; the City Council of Dresden, for example, last month discussed a statement that the postal authorities threatened to close the telephone exchange for twelve months, to put a stop to the continuous complaints from all parts of the community. The service was described as insupportable, scandalous, and detrimental to the commercial life of Dresden—but the charges had to be paid all the same, in advance. The council resolved to demand redress from the postal authorities.

On the other hand, a postal official stated that the alleged threat had not been made—but probably, as in London, the different departments of the German post office act in ignorance of each other's movements. To sum up the whole: State management is mismanagement now, as it always has been, and, after all, the people who brought it about have only themselves to blame. We warned them.

The obvious moral, to those contemplating government, state or municipal ownership of telephones, is *Don't!*

THE ADVERTISER'S SELECTION.

WHERE there is more than one trade paper catering to a certain field (as is generally the case), the advertiser feels that he must either patronize all of them or plunge into a labor of analysis for which he has little time or inclination. While the problem is not a complicated one, the several factors of total circulation, distribution of circulation, character of circulation, editorial policy and appeal, general appearance, technical reliability, frequency of issue, and space rate all go to make up the total value that decides the advertiser for or against a medium.

In the July number of *Advertising and Selling*, a man who has charge of the advertising of one of the large machinery manufacturers tells "How I Select Technical Magazines for Advertising Purposes." An advertising manager's mere statement that he does thus

and so leaves plenty of room for differences of opinion; but a lucid explanation of his reasons for selection makes a logical appeal to common sense that is hard to refute. We present his explanations not merely for the relief of resting upon the decision of some one else, but because we find his presentation of the case so excellent that we can neither add to it nor subtract from it:

I often envy the mail order advertiser because he knows just where he stands with his advertising. He puts an ad costing a certain amount in a certain magazine and if by a certain date the "Orders Received" column on his net record card does not add up to a certain figure, it is up Salt river for that magazine. His is an exact science. At least so I am told. May be the mail order man has his troubles. I don't know.

However, I am fully aware of my own troubles and one of them is that it is difficult if not impossible to determine what the value of any given medium is to me.

I am endeavoring to exploit certain lines of machinery and naturally use technical magazines to a considerable extent. I know that this advertising as a whole is very profitable because I have found that the salesmen make slow work of introducing a new line until the technical paper ads begin to appear and then the sales brace up. Some of these periodicals are certainly worth their weight in gold to me and others are probably a losing investment but the difficulty is to separate the sheep from the goats.

Buyers unfortunately do not send in orders by mail on the strength of my advertisements. They do not even write me encouraging letters asking for literature or use to any other enticing suggestion that I dangle before them. No. They maintain an air of sullen indifference, refusing to give me the slightest inkling as to which are their favorite literary companions.

Of course, I do receive some inquiries but their number is insignificant when the total volume of advertising is considered, for I use over 100 technical magazines. Keying has demonstrated that almost every magazine pulls to some extent, but although I have been watching this matter carefully for some time, I am unable to come to any definite conclusions as to the relative value of the various mediums I use.

Yet it is highly important to determine this point by some means or other. Our machinery is used in a large number of industries and since I am naturally not provided with a sufficient appropriation to advertise in all the possible magazines I must make a selection somehow. Hence I must resort to analysis and deduction, my method being briefly as follows:

In the first place the industries to which I shall advertise is determined each year by consultation with the sales department and the appropriation for technical advertising is divided, in general, among these industries in accordance with the amount of business done in each during the preceding year. Of course the development of new apparatus and some other considerations will modify the amount given to certain lines.

I keep a card file of all the technical magazines that might be of use to me. These are divided into the various industries they represent, such as automobiles, textile manufacturing, coal mining, metal mining, wood-working, etc. If a magazine covers more than one industry, according to my classification, it has a card in each division. On each card is entered the name of the periodical, details as to size of page, date of issue, etc., the price of one page with a yearly contract of a page in every issue (this is for comparison; rate cards are of course kept separately), character of editorial matter, whether technical, popular, financial, or commercial, and an analysis of circulation as follows:

Total paid circulation.

Geographical distribution by sections, i. e., New England, Middle Atlantic, Southeast, etc.

Percentage of each of the following classes of readers: executives, superintendents, workmen, dealers, engineers.

Part of this information is obtained from a study of the magazine and part from the publishers. I find little difficulty in obtaining the total circulation and its geographical distribution, and in the few cases where it is refused I do not use the magazine as I feel I must know what I am buying.

As regards the character of the readers, some publishers prepare very complete analyses and these are of the greatest assistance to advertisers, especially those like myself who must depend upon "dead reckoning" to determine the value of the medium. Almost all publishers supply such information as they are able to obtain, but in many cases they can not classify their readers accurately, and this introduces an element of uncertainty.

Salesmen's reports also furnish considerable information as to the character of certain magazines but these are at the best very general and can not be relied upon to settle finer points.

In preparing the year's schedule the periodicals for each industry selected are considered separately.

The first step is to eliminate those circulating in sections where we can not or do not sell. For example, we can sell certain machines to the loggers of the Northwest, but can not in any quantity to those of the South because conditions there are different.

The next to be weeded out are those going mainly to workmen and dealers as this circulation is useless to us. The remainder are possible prospects.

The next step is to measure the appropriation for the industry under consideration so as to determine how many of the magazines left can be used. In some industries I feel I need full pages to state my case properly, while in others half pages seem sufficient, depending upon whether buyers are well educated to our position or not. I endeavor to appear in every issue of the monthlies and at least in every other issue of the weeklies. If I have money enough to use this amount of space in all the magazines remaining after the first elimination I use them all; if not, I refine further step by step until my appropriation fits the residue in hand.

The first to go are those that are inferior in editorial matter and make-up. The next are those that appeal to executives rather than to managers and superintendents. I feel that these latter are more active in specifying machinery than presidents and directors, who are not active managers. Writers of commercial technical papers disagree with me in this, but I have yet to change my views. Of course I realize the value of appealing to executives on matters of increased production and economy and do so whenever possible; but I am here considering a case where I am embarrassed by the presence of a number of good mediums and the absence of sufficient cash to use them all, and hence must select only the most desirable.

If I still have too many mediums for my pocket book, I choose monthlies and leave out the weeklies. I do this because monthlies have a longer life than weeklies, and being read more for instruction than for news, they are probably more frequently read at leisure so that the advertising pages get a better chance. Moreover, twelve ads per year in a monthly create a stronger impression of persistence and continuity than the same number in a weekly, and if I have analyzed thus far it is because economy is necessary.

There are at least five points in this discourse that should be particularly impressed upon the mind of every trade paper advertiser:

1. Buyers do *not* mention the advertisement that interests them.
2. Salesmen make slow work of introducing a new line until the trade paper ads begin to appear.
3. The first papers to be rejected are those of inferior editorial matter and make-up.
4. The paper that appeals to managers and buyers must be selected in preference to that which appeals to executives.
5. Choose the monthlies and leave out the weeklies. Monthlies have a longer life than weeklies and being read more for instruction than for news are read more at leisure, so that the advertising pages get a better chance.

These are the cardinal points of trade paper selection according to an expert—and, better still, according to common sense.

BOSTON LOSES A COMPANY

The Massachusetts Telephone and Telegraph Company, operating in Boston in the shoe and leather district and having about 115 subscribers, discontinued its service July 15. Practically all its subscribers were stock brokers who were given a direct wire service. This service will be supplanted by the system of the New England Telephone and Telegraph Company, which purchased the Massachusetts Telephone and Telegraph Company last January.

The Betulander Automatic System

By Eugene Dengler

A SYSTEM of automatic telephony has been used for some years in a number of small exchanges of the Swedish government's telephone department. A 1,000-line demonstration plant is also erected in Paris. The whole of the plant is under the direction of C. B. Clay, who is superintending this department for Marconi's Wireless Telegraph Company. Although this system has only been employed for small exchanges, recent improvements in the selector switches and additions to the equipment included in the circuit have rendered it suitable for the largest installations, and it is now capable of giving a telephone service similar to that given by manual exchanges, including party lines and the registering of measured rate calls. It has the advantages of flexibility, simplicity and great rapidity of selection.

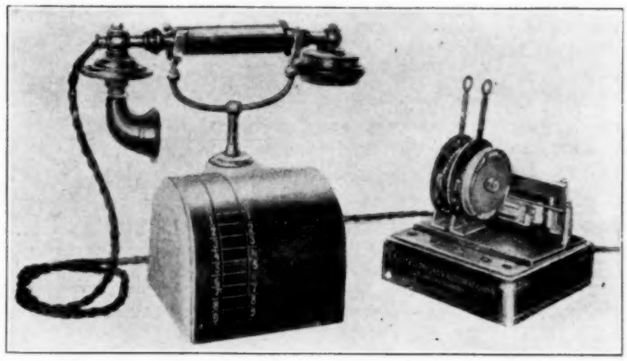

Fig. 1. Subscriber's Apparatus.

The features of the Betulander system are as follows: The subscriber's apparatus shown in Fig. 1 consists of the usual type of telephone to which an actuator or impulse sender is attached. The number required is set up by putting forward the keys of the actuator the requisite distance, as shown on the case of the instruments. The units, tens, etc., have a separate lever, and the calling mechanism is so arranged that the number must be called in the same order that it would be written, thus ensuring a freedom from wrong numbers. For example, in a 10,000 line system, the thousands digit would be set first, then the hundreds and so on. When the number is established the keys are automatically returned to the normal position on the removal of the telephone from the rest. The telephone instrument itself can be of any of the well-known types.

The exchange apparatus is the most interesting part of the equipment. In the case of the Betulander system, as in most other automatic systems the relays play a most important part. These relays are of a form which common-battery experience has shown to be reliable and economical. Each subscriber has a set of relays and condensers. No matter what the ultimate capacity of the system may be, the set will consist of four simple relays; the first three for receiving the actuator impulses and transmitting them to the various selectors, while the fourth relay only comes into play when the particular subscriber is being called, and is for the purpose of connecting the ringing current to the called subscriber's line. In addition, the relays, in conjunction with the condensers, perform the usual functions in a central-battery transmission system. The sets of relays and condensers are assembled together in blocks of 10, each serving 10 subscribers. The number of sets can always be maintained strictly equal to the number of working subscribers, it being possible to equip the spare racks at any time. This system, therefore, possesses great flexibility with regard to extensions, being ready at any time to take care of an increase of business by a single addition, while the fact that the apparatus is easily interchangeable is also an advantage.

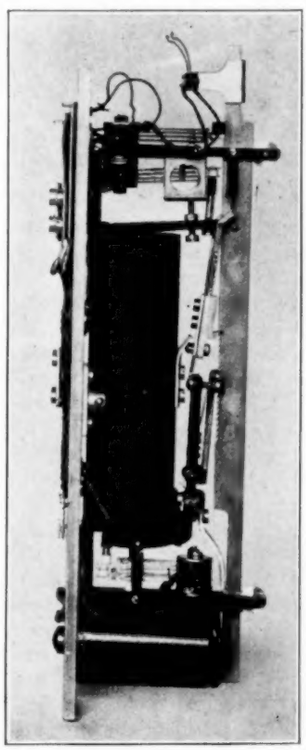

Fig. 2. Group Selector.

The fundamental principle of each type of selector is the same, and all the principal parts are identical. Fig. 2 illustrates one of the selectors, which have a vertical movement only and are of a very simple design, consisting of only three electromagnets, the first two of which are assembled in a common sheath, but are constructed to have separate magnetic circuits. Each is assigned exclusively to a line wire and receives the impulses from the actuator through the subscriber's line relays, and the operation and release of the selector is effected by an ingenious but simple arrangement of pawls. The third electromagnet is operated from a local circuit through the contacts of one or other of the first two magnets, and serves principally to hold the wipers out of the contact fields during all movements of the selectors, thus obviating all unnecessary wear and ensuring secrecy.

The selectors are mounted on iron frames in groups of 10 and each is clipped in position by a spring. They can be taken out and replaced in a minute by any intelligent person, connection being made by contacts on the mounting plates registering with springs fitted on the rack. These racks also carry the contact fields to which the various lines and junctions are connected. The contact fields consist either of continuous lengths of bare wire suitably supported or segments of non-oxidizable metal. The design of the contact fields considerably reduces the number of soldered contacts, and is so simple in arrangement that faults are practically impossible. For very small systems these contact fields can be made so that the equipment at the central exchange is reduced to one set of relays and one selector per subscriber. Such a board is shown in

Fig. 3. For larger systems each subscriber has allotted to him a selector called a pre-selector of the type previously mentioned. Immediately the actuator has been released by lifting the telephone, the pre-selector automatically and instantaneously selects the first disengaged junction to a group selector. The subscriber's actuator and relays are then extended through the pre-selector to a group selector which now responds to the first series of impulses sent out by the actuator, the pre-selector in the meantime having been automatically locked in position and disconnected in order that it will not be affected by subsequent impulses. Each group selector has an auxiliary selector permanently allocated to it, the function of which is to seek for an idle selector in the next group, which in its turn responds to the next series of impulses sent out from the actuator, and so on through the whole of the selectors necessary to find the "called" subscriber. The number of selectors through which it is necessary for a call to pass depends upon the ultimate capacity of the system. When the final or "unit's" selector has found the "wanted" line, the signaling relay, if the line be disengaged, is immediately actuated and sends the ringing current out to the line at regular intervals until the called subscriber replies, or the calling subscriber replaces his telephone on the rest. The connection having been established, the calling subscriber is able to hear his correspondent being rung. Should, however, the called subscriber's line be already engaged, the "unit's" selector, as soon as it reaches this line, instantly returns to normal, causing the return to the normal position of all the selectors in the series which were used to form the connection. As the calling subscriber hears the usual busy signal he knows that the desired line is unavailable. When either of the telephones is placed on its rest, the whole of the selectors used in the connection are immediately restored to normal, so that the line is instantly available in case of another call. This is a necessary feature of automatic service.

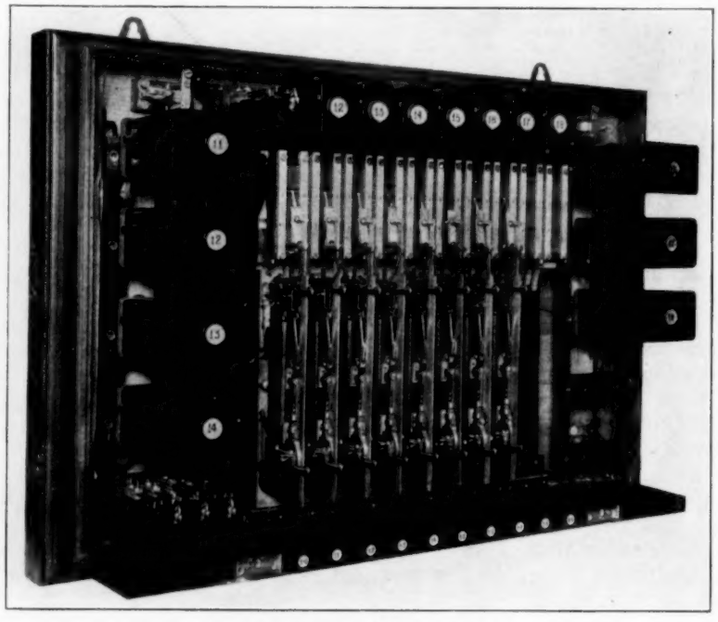

Fig. 3. Complete 10-Line Installation.

Fig. 4 illustrates the apparatus which would be employed in establishing communication between two subscribers in a system designed for 1,000 lines, but for clearness equipment for only 200 lines is shown in the diagram. The maximum traffic is assumed to require 10 per cent trunking. The hatched selectors are those which would be necessary if a 6 per cent trunking were sufficient for the traffic. In the figure two subscribers' instruments are represented by Nos. 238 and 645, and it will be assumed that subscriber No. 645 after setting up the number desired on his actuator lifts the telephone from the switch hook. An impulse is transmitted over the line *A* to the relay set *B* belonging to the calling subscriber, which in turn operates the subscriber's pre-selector *C*. This pre-selector automatically and instantaneously selects the first idle line of the group of trunk lines *E* assigned to the group of subscribers to which No. 645 belongs. Assuming in this case that the first free line is the second trunk, the connection is thereby extended to the corresponding "hundred's" selector in the group *F*. This selector receiving the first group of impulses sent out by the actuator will be stepped up to the third position, selecting the "hundreds" group in which the called subscriber is located. The connection is now extended to an auxiliary "hundred's" selector. This is one of the group of 10 (shown at *G*) to which all subscribers between the numbers of 600 and 699 have access when calling for any number between 200 and 299. The auxiliary "hundred's" selector immediately operates to find a trunk line connected with an idle "ten's" selector, which in this case we will assume to be the fifth. The connection is now extended to a "ten's" selector, the fifth in the group *H*. The second set of impulses sent out by the subscribers' actuator serves to operate this "ten's" selector, stepping it up to the fourth position, and thereby selecting the ten 30 to 39 of the hundred 200 to 299. Corresponding to the fourth position of the "ten's" selector are 10 "unit's" selectors *J*, all of which have access to Nos. 230 to 239. As the fifth "ten's" selector was used, the connection is extended to the fifth "unit's" selector which is operated by the last set of impulses and is stepped up to complete the connection. In this position connection is completed between the calling subscriber No. 645 and called subscriber No. 238, the complete connection being shown in dotted lines, so that the course of the call may be readily traced by the reader.

In the diagram there are also shown the selectors which are brought into operation when a call is made between the same two subscribers, but in the reverse direction—*i. e.*, from the subscriber No. 238 to subscriber No. 645. The completed connection is shown in heavy lines.

It is claimed for this new system that its simplicity and flexibility allow the equipment to be in exact agreement with the actual number of working subscribers' lines, while its great accessibility during working and the ease with which extensions can be made is a great advantage. Owing to the fact that the actuator is completely set up before any impulses are sent to the exchange, delays due to faulty or tardy manipulation of the calling device do not occur, and the various selectors are therefore always engaged for a minimum length of time. This, together with the fact that disconnection at the completion of a call is instantaneous, and that the selec-

tors on ascertaining that the wanted line is engaged immediately restore to normal without waiting for the subscribers to "hang up," enable an unusually low percentage trunking to be employed. Careful observations have shown that with the Betulander system a higher rate of trunking than 10 per cent is very exceptional, and, in fact, the rate rarely exceeds 6 or 7 per cent. The current consumption is light, and a battery of accumulators of small capacity may be employed, provided that the internal resistance is low. A very simple arrangement of relays is used for providing the ringing current and interruptions. The device is self-starting, which makes the system eminently suitable for rural exchanges. The arrangement of the contact fields is such that the cabling is reduced to a minimum, making the apparatus

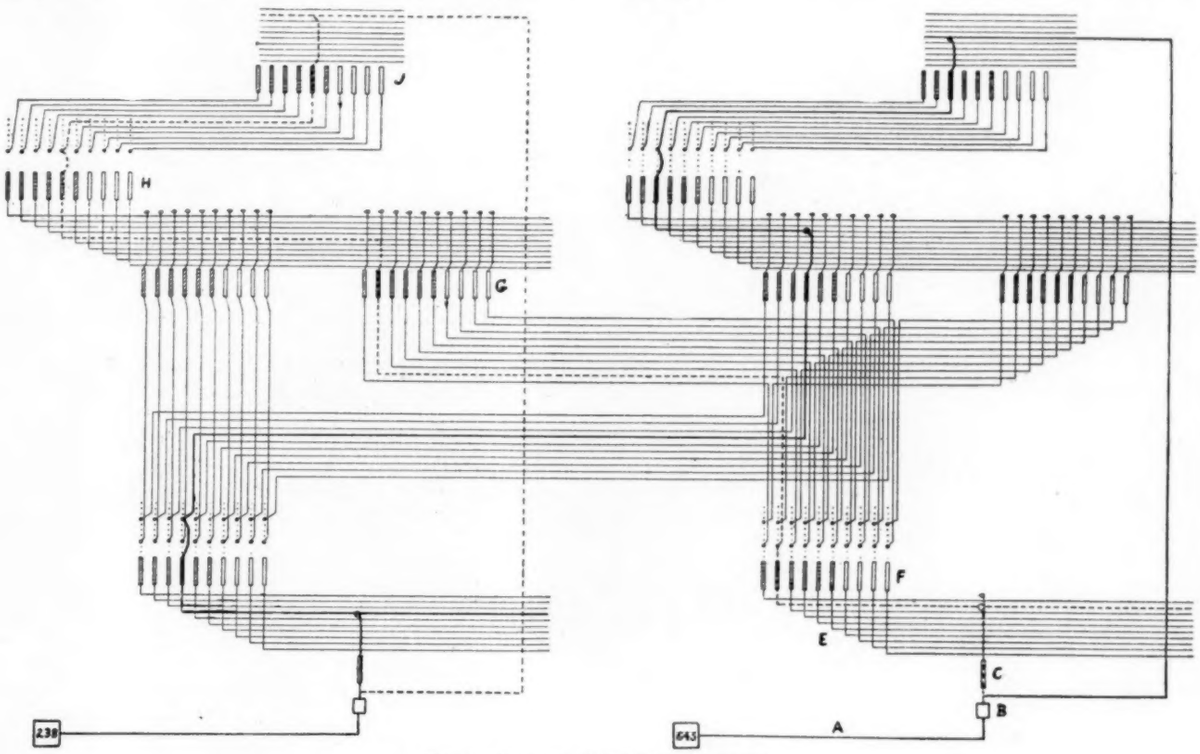

Fig. 4. Diagram of Exchange Apparatus.

easy to maintain, readily accessible and economical to install. The fact that the working parts can be changed by an unskilled person without breaking any soldered connection renders the system specially useful in small places where skilled attention is not always available. The Betulander system is equally applicable to semi-automatic or full automatic working, and can at any time be converted from semi-automatic to full automatic without undue waste.

Reporting on the prospective installation of an automatic telephone system in a foreign municipality, An American consul writes that the local telephone director states that the time involved in correspondence with the United States practically precludes American firms from successfully bidding on the local project, unless they send personal representatives. Proposals, however, may be sent to this person, who states that they will be given full consideration if they contain sufficiently detailed specifications regarding the system proposed.

Inter-State Lays Submarine Cable

The War Department of the United States has granted to the Inter-State Telephone and Telegraph Company the right to lay on the bed of the Illinois River a submarine telephone cable from Peoria to East Peoria, Ill. This improvement became necessary because the cable now crossing the bridge of the Illinois Traction Company is in too close proximity to high voltage wires. Moreover, the P. & P. U. is about to install a large number of telephones in its new East Peoria yards, and there is a possibility also that the Inter-State may negotiate for the purchase of the East Peoria lines.

Also all the toll lines from the east will come in through the new cable, and it must be made large enough to accommodate them. The estimated cost of the entire improvement will be in the neighborhood of $20,000.

Chicago's Telephone Complaint Bureau

Establishment of Chicago's new bureau to investigate the complaints of telephone patrons was practically assured when the Council Finance Committee voted to appropriate $3,000 for its maintenance for the remainder of the year. The appropriation will provide for a commissioner, an investigator and a clerk. An ordinance creating the bureau has already been passed by the council.

Montague Ferry, a consulting engineer in the city electrical department, will probably be the head of the new telephone complaint bureau, according to City Electrician Ray Palmer. Already several complaints have reached Mr. Palmer.

The Lay of a Layman

By the T. E. Dopester

THE doctors tell us that hard work never hurts, provided it is seasoned with rest. This is one prescription the doctors offer which is quite generally accepted. Hard work isn't hurting many telephone men right now. Operators of telephone systems are giving their bodies a chance to recuperate. Switchboard operators do not get this opportunity. The heavy load is spread out over much of the day. Men in charge of business find it convenient to use a telephone on a hot day. But the girlies like to get out in the air, too, and if the service is low, you will please remember that vacation time has its call upon the switching force as well as upon the executives. Vacation time is a July and August institution. Our bodies call out for a complete change in scenery and occupation. Summer time is the city man's ideal vacation time, whether business booms or drags. In summer, city business slows down. The only good reason for it is charged to the vacation bug.

* * *

Given our own way about it, we would lock up the shop and discharge the help once a year—say about June 30. August 15 we would send out notice that the shop would reopen September 1. There would be no editions of Telephone Engineer for July and August. But that wouldn't be fair to the folks in the country, who never think of vacation time as we do. Out in the country the telephone exchange shuts up like a clam at ten o'clock Saturday night and reopens the following Monday morning. In extremely vigorous communities there is service for the subscriber on Sunday morning till ten o'clock and maybe some more between four and six o'clock in the afternoon. The vacation mania hasn't become an institution in the country. When the country develops the city habit we may adopt our plan, but not till then. However, dog-days are rightly named.

* * *

It is discomforting to try to enthuse in torrid weather. There isn't any punch in our prattle. From the city standard, everything dilly-dallies.

* * *

But we can lie under the trees and think more or less. And in thinking, our mind reverts first to Ohio, where telephone affairs were always liveliest in the years gone by and where there isn't a stir nowadays. I had breakfast in Cleveland a few weeks ago, at Statler's. I saw two telephone systems—local calls ten cents at either sign—blue bell or stars and stripes. It reminded me that Cleveland has about forty thousand stations and Cuyahoga thirty thousand. A few years ago there was a great pow-wow at Columbus, when they fixed up a statute that would enable these two systems to consolidate. Everybody seemed to agree that Cleveland should have but one telephone system, and after the Columbus event it was to have been clear sailing. Of course, it isn't any of our business whether these properties ever merge, but it would be interesting to know just why they don't. Cleveland Tel. offers outlet for its long-distance calls over A. T. & T. lines; Cuyahoga offers outlet for its long-distance calls over U. S. Tel. In Cleveland you just have to have the two systems to have telephone service. Duplications in Cleveland would cut down the systems, in the event of consolidation, to nearly fifty thousand stations and practically make junk of one or the other of the long-distance equipments. J. P. Morgan & Company was the big purchaser of the independent properties in Ohio. No one need blame the Ohio Public Utility Commissioners because these properties do not get together. The A. T. & T. can read a balance sheet in its favor. Consolidation isn't such an alluring proposition if both systems pay. Cleveland is an example of how telephone competition might be made to work out if the independent operator had backbone enough to develop and hold.

* * *

You know that we are charged, sometimes, of being Bell-owned ourself. During the past several years we have been charged with nearly everything Bell or anti-Bell. A publication that dared to invade the sanctity of the telephone field and declare a middle-of-the-road policy was apt to have the road pretty much to itself. And as we went along, there have been times when it looked to one side or the other that we were playing favorites. In cases like Cleveland for instance, it wasn't becoming to allege that Bell might own both operating plants in that place and would operate both at a profit, providing that was possible. The independents would prefer to think that Cuyahoga was the irresistible stem to the situation. The truth is that independents, ever since Theodore N. Vail flirted his peace proclamation at the Blackstone hotel, Chicago, have been wondering when the Bell agents would be around to look 'em over. Their holier-than-thou policy has been their partial undoing. The Bell Telephone Company doesn't bother itself about a telephone system that doesn't bother it. The independent operator who is waiting for the Bell to buy him out has an all-the-year-around wait on his hands. If there is anything the Bell doesn't want it is the operator who lets well enough alone.

* * *

From my little observation tower I can see no good excuse for an independent operator to await the call of the Bell agent. The Bell agent is the man who hears the racket of real competition. When it begins to make a dent in the Bell balance sheet he comes forward without announcement and he sticks around until peace has been restored. In Cleveland the boys borrow material of each other.

* * *

You will have a merry time in explaining why John Joseph Carty went to Europe a few years ago and threw the hooks into machine operating at a time when his company was developing such a system. There has never been a Carty apology because his company has spent millions of dollars in an effort to acquire all such patents. I ran across an item which

tells me that there is a possibility of the American Automatic Telephone Company at Urbana resuming operations, because the Bell recently paid $75,000 for its patents. The idea being, if the Bell wants it, it usually gets it.

* * *

A great fuss is being made in Chicago because the Bell is buying or has bought the automatic system. It bought San Francisco and scrapped the most beautiful plant ever conceived by man. A building designed for a central station plant was converted into general offices for Bell officials. The competitive system in Chicago must have been something that the Bell wanted and it is safe to assume that the Bell has it now—ahead of the fireworks. The smoke of 'Frisco has cleared away.

* * *

There was a time when independents wondered where Bell got the money—but that isn't a moot question any more. The Bell always seems to have the necessary funds to accomplish its purpose. The problem that gives us largest concern, is why it buys some things.

* * *

If it was possible to prevent the Bell method of spending its own money, the only agency we might recommend for the task would be the National Independent Telephone Association. Why do we never hear of it except at convention times?

* * *

At rare intervals there is a protest that the Bell should have a guardian. Out in the far northwest, your Uncle Sam is taking a hand in the matter. The Bell is being dragged into court on a charge of violating the Sherman anti-trust law. It is named as a trust in the states of Washington, Oregon, Montana and Idaho, because of alleged misdemeanors in the conduct of the telephone business. To a man up a tree this is discordant music, because it was only a little while ago that the attorney-general gave it out officially that the Interstate Commerce Commission would handle telephone cases. President Wilson, it may be recalled, is a middle-of-the-roader in competitive business affairs. His cabinet might safely be listed under the same classification. When the attorney-general showed a tendency to side-step, it was quite thoroughly understood that Wickersham had an emulator. Now comes the story of an honest-to-goodness attempt to adjust matters by the old rule. If independents have been wanting a chance now is the time. Summer excursion rates are in effect. Oregon is a great place in summer, according to the railroad folders.

* * *

From Allentown comes the good word that the old Consolidated Telephone Companies of Pennsylvania are to be reorganized and rehabilitated. Early this year, in February, if our memory holds, the receivers of the American Union sold the Consolidated to a syndicate. After these several months, the syndicate finds that there is every reason to go ahead with the property and develop it. It is only another case proving that the telephone, properly handled, is the safest investment ever offered for money. I am fearful, however, that the reorganization committee is burdening the property with too large a load. There appears to be only 19,000 instruments in the system, representing thirty-six exchanges. Something like $5,000,000 in securities are to issue. Unless there is an unusually large amount of realty and buildings, this seems to be a stiff lug for the present installation.

* * *

LeRoy W. Stanton has commenced to install another telephone system at Rock Island. You positively cannot lose some of the fellows, no matter how hard you try.

* * *

And the old National at Wheeling is discharging its receivers. At the end of thirty-nine months the court has been convinced that a telephone property can take care of itself if it is jimmied loose from the promoter.

* * *

Up at Mitchell, S. D., the city dads tried put one over on our good friend J. L. W. Zietlow, by passing an ordinance to regulate the telephone company Mr. Zietlow told the aforesaid city dads to play horse all they wanted to, but before he would stand hitched, he would move out. The judge has the case to ponder over. Mr. Zietlow says it would cost him $35,000 to move out, but that would be less than half the cost to stay. It is comforting to find a fire-eater once in a while. Mr. Zieltow has been charged with many things, but never with being a bad telephone operator.

* * *

A decision of the U. S. Supreme Court has held as being valid, one of Michigan's new laws which imposed a lot of back taxes and penalties on the Citizens Telephone Company of Grand Rapids and elsewhere. In consequence, it is reported that the Citizens will reduce its dividend rate from 8 to 6 and join the hosts who indulge fashionable finance and issue some bonds. It is hard enough to pay taxes as we go along, but it is tough to get a jolt of $134,000 worth when you're not looking.

* * *

Adolphus Busch lost his suit against Stromberg-Carlson and had to come across with another $20,000. That is harking back some. This is an echo of the days before S.-C. moved to Rochester. I had almost forgotten that St. Louis was a bidder for the factory site. I wonder whether Adolph knows that Pilsener is the favorite brand in Rochester.

* * *

Now that the Chicago Telephone Company is out for the automatic system, we shall expect to hear a big protest from down state. The boys who grabbed up the fragments of the Evans-Conklin system and breathed the breath of life into that property have been the god-fathers of the Chicago independent plant. They broke a bottle of wine over the soldered connecting joints when Inter-State and Illinois Tunnel met and there must have been a contract of some sort. While it is known that Chicago Telephone Company has large holdings in Inter-State, the bunch at Aurora have never become reconciled to Mr. Sunny's method of doing things. I'll guess that a roar comes out of Aurora when it realizes that the automatic is threatened in Chicago. It was only a week or two ago that I asked for more automatic service and unless the installers hurry I'm expecting the Bell crowd in here to ask what they can do for me! Great little business we're in, as sure as you live.

Next month TELEPHONE ENGINEER will begin to fatten up a bit. We have suffered more or less picking for several issues. For one excuse or another customers have begged to be let alone for a little while. No reason is given and our arguments have had no immediate effect. For fancied notions, advertising suffers more or less during warm weather. Men roll up their sleeves to save their cuffs and their arms stick to the desks. It isn't comfortable to dig into cut cabinets for electrotypes which are stowed in unhandy spots. They realize that sheer laziness is apt to show in their copy and it is disheartening to appeal to men whom they feel are fishing instead of working. Thus we suffer. Our business of getting out the book can find no respite. She's got to come out, no matter whether the sun beats through the windows and the copy paper sticks to our arms. It's all in the game. But did it ever occur to you that we give you more text in a single issue of TELEPHONE ENGINEER than you ever got before in a journal to the trade? TELEPHONE ENGINEER is nearly all text. That is why subscribers have been our especial delight for the past four years and a half. Some of them have formed the habit of renewing their own plus one—a gift to a fellow worker. Joy be always with them!

* * *

Following our usual custom the September number of TLEPHONE ENGINEER will carry a 16-page Manufacturers' and Suppliers' Index. Every advertiser is entitled to listing in black-faced type—a feature that is helpful in more ways than one and troublesome only to us. But whether an advertiser or not this compilation carries your name and with your help lists you under the captions of the several things you make. Now is the time to get your copy in for the September number.

Eastern Pennsylvania Telephone Men Meet

With a banquet at the Colonial Hotel at 1 p. m., a final business session at 2:15 p. m., and a special trolley car tour of the city, the first quarterly meeting of the Eastern Pennsylvania Telephone Association, at York, Pa., came to a close July 16. The entertainment was provided by the York Telephone and Telegraph Company.

George B. Rudy, general manager of the York Telephone and Telegraph Company, read a paper on "The Switching System," at the session held in the afternoon. He stated that this system had been installed in the local exchange, and since it has been in service has paid for itself several times.

C. C. Frick, president, and H. H. Weber, treasurer of the York Telephone and Telegraph Company, took part in the discussions at the morning and afternoon sessions.

The meeting was opened at 9:30 a. m., by J. F. Stockwell of the Keystone Telegraph Company, Philadelphia, president of the association.

President Stockwell gave a short talk upon the utility bill, dealing with those sections referring to the telephone service. Quite a little feeling was shown by some of the delegates over the emasculation of the bill. The opinion was prevalent among the telephone men that the section of the bill which was killed by the legislature would have ultimately given the independent companies service with telephone users in New York City, Washington and Baltimore.

Secretary Bradley, of the Eastern Traffic Association, presented the greetings of the Western Pennsylvania Association. Mr. Bradley gave a brief talk on the complaints of connecting company managers, whose difficulties may be either lack of supervision in routing messages or an absence of information on the part of operators in knowing the points reached by their trunk lines. An increase of $20,000 in toll business among independent companies over the same period last year was reported.

"The Necessity of Improving Transmission Over Long Distance Lines" was the subject of an address made by A. J. Ulrich, traffic manager of the Keystone Telephone Company, Philadelphia. Mr. Ulrich urged that more co-operation be manifested among the various companies represented in the association.

Electrical Engineer Forsche, of the Pennsylvania Railroad Company, addressed the delegates on the subject of "Phantom Circuits." Mr. Forsche advised the operators as to the availability of utilizing all their circuits by means of the phantom coil. Addresses were also scheduled by Henry M. Tracy, managing receiver of the Cumberland Valley Company, and W. B. McCaleb, receiver of the United Telephone and Telegraph Company, but both men were absent.

The program of the day included a tour of the York Telephone and Telegraph Company's plant, which was made after the morning session.

The selection of the place for holding the next quarterly meeting, three months hence, was left to the executive committee. The third quarterly meeting, six months hence, will be held in Philadelphia.

The officers of the association are: President, J. F. Stockwell Philadelphia; first vice-president, M. E. Reeder, Hughesville; second vice-president, Joseph F. Ogden, Tunkhannock; secretary and treasurer, O. K. Kines, Harrisburg; executive committee, J. F. Cockwell, Philadelphia, chairman; G. B. Rudy, York; Cameron L. Bear, Harrisburg, and C. A. Carl, Harrisburg.

California Commission News

The California Railroad Commission has rendered a decision in which it grants authority to the Pacific Telephone and Telegraph Company to withdraw from territory in and about Compton, and also authorizing the Consolidated Utilities Company to withdraw its telephone service from the territory in and adjacent to Watts Station, Los Angeles county. The commission also authorizes the companies to enter into an agreement under which ample telephone service will be provided for the communities concerned. The effect will be to curtail certain free switching between Watts Station and Compton, and to extend switching privileges between Watts Station and the city of Los Angeles.

The Delano-Linns Valley Telephone Company of Kern county, Cal., and the Pacific Telephone and Telegraph Company have applied to the railroad commission asking that the Pacific Telephone and Telegraph Company be authorized to withdraw from a certain section in Linns valley and to turn over the business to the Delano-Linns Valley Telephone Company.

Automatic Methods in Long Distance

By H. M. Friendly and A. E. Burns*

UNDER usual practice, through switching introduces relatively expensive operating methods, due to the fact that more operators and more line circuits are required than to handle the traffic over direct trunk lines, and direct way-lines; thus meaning lower earning efficiency to the operating company and retarded service to its patrons, the latter doubtless having a potent though intangible effect in discouraging business as well. In the first case mentioned, employing usual methods, the Portland operator desiring Tacoma would first be obliged to signal Centralia or Chehalis in the usual way and await the operator's convenience in responding; then tell this operator her wants, and again wait until she ascertained the state of the desired line, and reported back, if busy, thus consuming the time of two operators, and what is of far more moment—the time of the line. An operator establishing her own through connections by remote control avoids such delays—in fact gains all the advantages of direct trunk efficiency between points where the volume of traffic does not warrant the expense of the proper number of trunk lines to carry the maximum or "peak" demand without delaying traffic unduly, or where the advantage of direct trunk or direct way service is desired but not warranted by the traffic offered. The delays experienced in establishing through connections manually at intermediate offices are augmented by the delay in getting the established connection taken down at the termination of the service, or annoyances such as an inadvertent disconnection at the through office. In the remote control method, the withdrawing of the plug by the calling operator instantly disconnects the lines, and not otherwise.

Operators maintain that there is far less nerve strain and fatigue attaching to the remote control method of establishing through switches than with the manual method where the enforced delays under stress are very trying.

In order to facilitate "rapid fire" service between Portland and Seattle, a distance of 185 miles (297.7 km.), an unusual traffic and circuit arrangement was devised. But one trunk circuit was available, a No. 8 B. & S. copper loop having no intermediate offices obtaining service over it, and since many calls to Seattle were special calls or through calls to points beyond, it was necessary that the Portland operator should be able to signal the Seattle toll operator at will in the usual way without disturbing the Seattle *B* operator. Following the regular line jack on the Portland switchboard is an auxiliary jack that may be called the *B* board jack, which is used when the Portland operator desires to order up a number directly via the Seattle *B* board, the Portland operator upon plugging into this jack being able to speak directly into the head telephone of the Seattle *B* operator over the regular toll line without further preliminaries, and remains so connected until the *B* operator plugs into the called subscriber's line. Over the *B* board jack at Portland are placed two lamps which indicate by glowing that the Portland operator is not restricted by the Seattle toll operator, and further that she is in connection with the *B* operator's head telephone, and thus can proceed to order up the desired subscriber's line. The extinguishing of the second lamp indicates that the *B* operator has inserted the line or trunk plug into the local line jack. A lamp is placed over the jack of the line on the Seattle toll board, which by glowing indicates to the operator that the line is in use to the *B* board and is cut off at the toll board, the busy lamp being also lighted over the answering jack and its associated multiples.

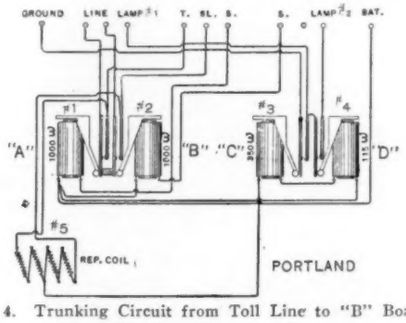

Fig. 4. Trunking Circuit from Toll Line to "B" Board. (See Figs. 5 and 10.)

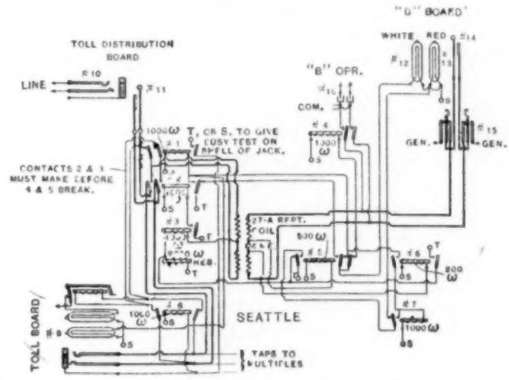

Fig. 5. Line Circuit—For Direct Trunking from Toll Line to "B" Position (See Figs. 4 and 10).

The principle of operation (see Figs. 4 and 5) is that the Portland operator by plugging into the *B* trunk jack causes battery current to be projected out on the line which operates a relay at Seattle, cutting the line into the *B* operator's head telephone set, whereupon the Portland operator proceeds to ask for the Seattle local number, just as a Seattle *A* operator would, specifying however, "on 16," such being the number of the *B* plug associated with the toll line, as otherwise the *B* operator would not know what *B* plug to use. This cutting into the operator's set is accomplished through the agency of relay *A*, Fig. 4, which is operated from the shell wire of the *B* board jack. The current flows through two relays in series, relay *C* and *D*. Relay *C* is adjusted to operate through a resistance of 4000 ohms, while relay *D* will not operate through a resistance of over 2000 ohms, which gives a margin of adjustment that is used to give supervision in the following manner: If the switching apparatus is on the line, that is, the Seattle toll operator

*Concluded from July. Paper presented at the 30th Annual Convention of the A. I. E. E., June 24, 1913.

has no plug in the line jack, relays *C* and *D* pick up and light the supervisory and guard lamp associated with the Portland *B* board jack, assuring the Portland operator that she has the circuit to the Seattle *B* operator's head telephone set. This same current operates relay No. 3, Fig. 5, which controls relay No. 2, a cut off relay which disconnects the toll switchboard, lighting a lamp over the answering jack and the associated multiples and thereby apprising the toll operators that Portland has the line in service via *B* board. Relay No. 2 also operates relay No. 4 which cuts in on the *B* operator's head telephone circuit. When the *B* operator inserts the trunk plug associated with the toll line into the called subscriber's line, or into a trunk jack to a sub office, relay No. 5 operates, cutting off the *B* operator and lighting the subscriber's supervisory lamp on the *B* board. Relay No. 6 operates when the subscriber answers, extinguishing the *B* supervisory lamp, and locking relay No. 7 in an operated position until the call is released by the Portland operator withdrawing her switching plug. Another action of relay No. 5 is to cut the 2000-ohm resistance in series with the line relays, causing relay *D* at Portland to fall back, lighting the guard lamp No. 2 and thus giving Portland notice that the *B* plug has been inserted in the called line. When the subscriber answers and relay No. 6 is operated, this 2000-ohm resistance is short-circuited, causing relay *D* at Portland to pick up again, extinguishing the second guard lamp and apprising the Portland

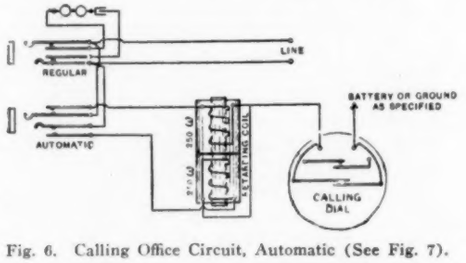

Fig. 6. Calling Office Circuit, Automatic (See Fig. 7).

operator that the subscriber has answered. When the Seattle subscriber hangs up, relay No. 6 falls back, removing the short circuit from the 2000-ohm resistance, and causing relay *D* to again light its associated lamp. The clearing signal is not given at Seattle until the Portland operator removes her plug, whereupon relays No. 3, 2, 1, and 7 fall back, and relay No. 5 being operated, causes both supervisory lamps to glow until the *B* operator removes the plug, when all parts of the apparatus return to the normal positions. In this condition the line can be used for normal toll purposes, ringing on the line operating the regular line signals only, the Seattle operator answering the signal by plugging into the line jack and cutting off the trunking apparatus by means of relay No. 8. This cut off feature gives the Seattle operator an equal chance of securing the line for outgoing business and renders it impossible for the operator at Portland to monopolize the line.

Except that the Seattle *B* operator is instructed to give the direct toll line trunks special attention, there is nothing to distinguish them in supervision from any of the local trunks, but a sounding relay associated with the lamps of the direct toll line trunks which is mounted beneath the keyshelf of the *B* board to aid in attracting the operator's attention to insure the most prompt disconnections.

Similar circuits were used between Tacoma and Seattle, provision being made also for Seattle to call Tacoma subscribers in the automatic exchange by means of an automatic calling device, which is described later in this paper. Calling with an automatic calling device as above has been tested successfully from Seattle to Portland, and there was no electrical reason for not employing it.

If, in calling Seattle numbers directly via the *B* board, the desired party was found to be out, the Portland operator would say, "have him call Long Distance 16." Upon the called party requesting this number of the Long Distance recording operator at Seattle, she understood that the call had originated at Portland, and after so informing him, obtaining his number, etc., would notify the operator on the Portland line who in turn notified Portland, who would complete the call via the *B* board.

Since the Northwestern Long Distance Telephone Company connected with the local automatic exchange of the Home Telephone and Telegraph Company of Portland, and local automatic exchange of the Puget Sound Home Telephone Company at Tacoma, before the latter was absorbed by the Sunset Telephone and Telegraph Company, the opportunity offered to improve the service to those cities by permitting distant connecting exchanges on the system of the long distance company to call subscribers at Portland and Tacoma by automatic means. It was decided at the outset that to insure satisfactory operating and traffic results, the normal uses of the lines so equipped must not be restricted in any way —that is, it must be possible to signal the toll operator at the city having the automatic local exchange in the usual way from offices on the toll line, and vice versa. Also that means be provided on the toll board for checking, supervising, and listening in on all switches called directly from the distant office to insure proper timing of service and handling of lines, and proper discipline; the latter being important for the reason that called local subscribers assume that the operator is also local, and would censure the toll company for any breach on the operator's part, it being remembered that the distant operators are not in the employ of the toll company. Further, than no call into the automatic exchange should be possible without the toll operator of that city being immediately apprised (by means of lamp signals above the line jack) of the attempt to call, and of the response of the called local subscriber.

At the distant office two spring jacks (see Fig. 6) are provided; one for normal switching, having a signal associated therewith; the other an auxiliary jack, being used for automatic calling only. The operator first ascertains by listening in on the regular or normal jack if the line is idle (if a way line), and then withdraws the plug and inserts it into the auxiliary jack and proceeds to "dial" the number without further preliminaries. On the completion of the dialing, two impulses are made by calling the digit "one" twice in quick succession which rings two short bells at the called subscriber's telephone in the automatic exchange. It has been found that this method of ringing is more convenient than to ring with the regular cord ringing key. However, by the introduction of an additional relay (as *E* Fig. 1) in the apparatus set at the calling office, such cord-key ringing may be effected. In such case the distant office would ring the local subscriber in the automatic exchange in the same manner as in ringing on a direct line. The automatic exchanges referred to are what is known as the three-wire Strowger system, thus necessitating the use of a ground in connection with the two line wires to

effect a call. In the first experiments looking towards the use of the automatic feature on the toll lines, the three-wire principle was adhered to, and gave satisfaction on those lines serving the two terminal stations only as trunk lines, but where three or more stations were served it was seen that to keep the two wires from any loop connections would involve too many complications in station equipment. Another thing that rendered the three-wire circuit on the toll line end practically out of the question was that any kind of ringing current used for signaling between stations would vibrate the relays of the apparatus set and cause a great deal of trouble in the automatic exchange. Due to the operating conditions of the three wire automatic system, this would be certain to cause a great many cut-offs and extraneous noises on other lines in the local automatic exchange. The so-called "two-wire" system of calling was therefore adopted, with the necessary modifications to translate from the two-wire system on the toll line to the three-wire system on the local automatic exchange. The only difficulty met was due to the fact that in this system the connector or last switch of the series involved in making a call in the automatic exchange drops back if the line called happens to be busy; a "vertical" impulse following which would ring on the called line if it had been selected serves to step the connector "off normal" and automatically gives the busy tone to the calling party. If, however, the "vertical" impulse were followed by a "rotary" impulse, the connector would again step up and another vertical or series of vertical impulses followed by a rotary impulse would select one of the hundred lines served by this connector, and ring some subscriber—almost certainly the wrong one. To guard against this, two different types of repeaters or translators were developed; one depending upon a small step by step mechanism (see Fig. 7) similar to that used by the automatic system in meter switches, and the other (see Fig. 9) depending upon a polarized relay being actuated by the proper polarity from the calling station, to eliminate the rotary impulses after the subscriber's number has been selected.

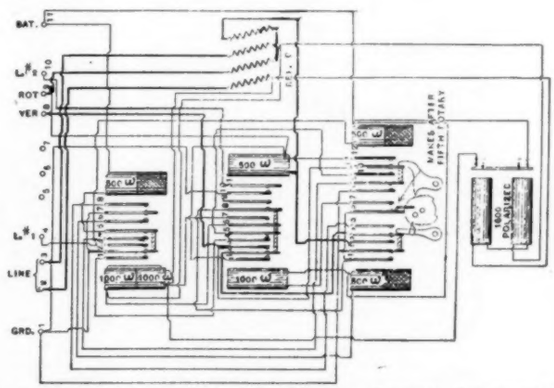

Fig. 7. Toll Line Automatic Apparatus Set—Reverses Rotary on Fifth Impulse (See Figs. 6 and 10).

The first method is the one used in the circuit shown in Figs. 6 and 7. In Fig. 6, the two line wires are connected to a double wound retardation coil, from the center of which the circuit can be traced through the contacts of the calling device (normally closed), to grounded battery, or if desired, to ground direct. To trace a call on these circuits, take for instance a station having the calling device grounded, and of course, having battery current on the repeater (Fig. 7); normally none of the calling station apparatus is connected to the line, and it is only when the calling operator plugs into the automatic jack that it is so connected. If the toll line is free, the desired local number is obtained by rotating the calling device successively according to the digits

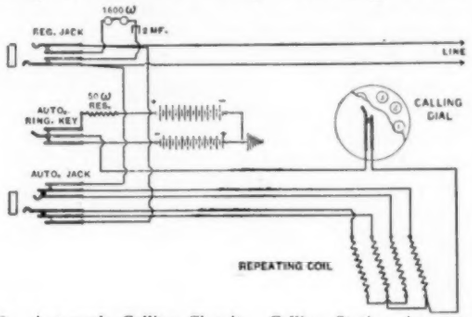

Fig. 8. Automatic Calling Circuit. Calling Station Apparatus for Polarized Ringing (See Figs. 9 and 10).

(and letter prefix corresponding to a digit) of the subscriber's number. If the digit 5 is called for instance, the ground will be interrupted five times in quick succession by the calling device, after which a comparatively long pause follows while the operator is preparing to "dial" the next digit. It is this prolonged pause which is utilized to give the rotary necessarily following each digit in the three wire system.

After the number has been selected, ringing, as before stated, is accomplished by calling two digits 1 on the calling device, giving a distinctive double ring peculiar to "Long Distance," the toll operators at the cities mentioned using a similar code in ringing subscribers. If the subscriber's line is busy the busy tone apprises the calling operator of the fact. If the called party answers, the call is handled in the usual way, and upon completion the apparatus is released by the calling operator merely withdrawing the plug for a second, after which the line and equipment is ready for another call. Fig. 7 is a set similar to that in Fig. 1, previously described, having point No. 1 grounded, Nos. 2 and 3 connected to the line wires, No. 4 to a lamp associated with the answering jack of this line, Nos. 8 and 9 to the vertical and rotary wires respectively of a trunk terminating in a "first selector" in the automatic exchange. No. 10 is wired to a second lamp associated with the answering jack, while No. 11 is main battery as before. The ground which was traced to the line wires in Fig. 6 may be followed through the two windings of the repeating coil, through the double wound relay *A*, through the contacts of relay *G* to battery. Relay *A* lights lamp No. 1, which apprises the operator that a call is about to be made, also operates relay *F*, which cuts in the trunk to the automatic exchange and throws a ground on the fourth spring of relay *A*. When the calling operator manipulates her calling device, the line circuit is broken a number of times corresponding to the digit or letter called. Relay *A* falls back with each impulse and "repeats" each impulse to the vertical wire of the trunk, and also causes relay *B* to pick up which in its turn operates relay *E*. Both *B* and *E* are sluggish relays, having a short-circuited winding or a heavy copper cylinder on one end of the core, and therefore do not fall back in the short interval between impulses, but do fall back in the longer interval between the various series of impulses corresponding to the several digits; first *B* falling back, then after a short interval, *E*. Tracing the circuit, with *E* picked up and *B* in the normal position, there is a

ground on the rotary side of the trunk, which serves to give the necessary rotary impulse at the end of each series of vertical impulses corresponding to the digits called. Each time relay *E* picks up it steps up the small ratchet wheel shown in Fig. 7, the steps being held by a pawl controlled by relay *F*. Each number of the automatic exchange is composed of five digits, as *A*1000, *B*1900, *C*3211, etc., and this wheel is adjusted to complete the contact of the spring actuated by it at the completion of the fifth rotary impulse. This operates relay *C* which reverses the automatic trunk, and disconnects the vertical impulses coming from relay *A*. When the calling device is again operated, this time to ring the subscriber, the same sequence of relay actions takes place as before, but as the vertical impulses are disconnected, the automatic trunk is not affected until the rotary impulse, and, the trunk being reversed, this is thrown on the vertical side of the trunk, ringing the subscriber, or if the line is busy, stepping up the connector switch to "off normal," and giving the characteristic busy tone. Upon the subscriber removing the receiver, battery and ground are thrown back on the trunk from the connector switch, operating relay *D*, which lights lamp No. 2, and apprises the checking operator on the toll board that the conversion is about to begin. When the call is completed and the calling operator removes her plug, relay *A* falls back, *B* and *E* picking up as before. After about one-half second, relay *F* falls back and disconnects the ground which operates *B*, consequently, *B* falls back followed by *E*, giving a rotary impulse as before. With *F* in a normal position, however, the automatic trunk is short circuited, and this causes the rotary impulse to give the "short and ground" necessary to release a call in the three-wire Strowger system.

The reason the trunk is reversed instead of the rotary being merely disconnected after the fifth rotary is that a false ring would be given on release before relay *F* fell back and released the call, thus calling the subscriber back to the telephone on a false call. Also, in case the calling operator discovered that a wrong number had been called, it would be impossible to release without giving a like false ring, all of which would not add to the prestige of the automatic system.

As stated before, grounded ringing power or ringing power subject to grounds must be guarded against when the switch is not in use, and this is accomplished by means of relay *G*, a polarized relay bridged across the line. When ringing impulses come in over the line, this relay vibrates, and keeps relay *A* from securing enough current to operate.

It will be noticed that lamp No. 1 flickers with each impulse from relay *A*, and these interruptions could be utilized to operate an indicator over the answering jack, or tape register if it was considered advisable for the sake of convenience in checking calls.

In the automatic apparatus set previously described (Figs. 6 and 7), the step by step mechanism is utilized to eliminate the rotary impulse after the fifth digit is called, but in the repeater set about to be described (Figs. 8 and 9) a reversal of the polarity or direction of the current is depended upon to accomplish the same result. The latter method has the advantage of a more positive ringing control, but has the disadvantage of requiring battery current at the calling station, minus polarity for calling, and plus polarity for ringing the subscriber. While the first set described required a step by step mechanism, the latter requires additional relays, which although not complicating the action of the set, still take up considerable extra space. Where the calling station has no battery supply, the former is the only choice; where battery is available, the choice is about even between the two systems with a slight preference for the second type on account of its more positive action. The operations of calling are identical and will not be gone into in detail, but to ring the subscriber the calling operator, using the latter circuit, depresses a self restoring key associated with the calling device which reverses the polarity of the battery as can be seen by tracing Fig. 8. This ringing of the called party in the distant automatic exchange could be accomplished by introducing a relay similar to relay *E*, Fig. 1, at the calling office, and using the usual cord ringing key.

The functions of relays *A*, *B*, *C*, *D*, *E*, and *F*, Fig. 9, in calling are practically identical with the functions of the similar relays in Fig. 7, and can be followed by reference to the preceding explanation of that circuit. The only difference is that the controlling relay *F* is operated by the polarized relay *G* (Fig. 9) which operates in the minus direction when actuated by the calling current. When the current is reversed by the ringing key at the calling station, relay *G* operates in the plus direction, operating relays *E* and *C*, the latter locking itself during the remainder of the call. Relay *A* not being sensitive to directional currents remains actuated and consequently relay *B* does not pick up. In this position, with relay *E* actuated and relay *B* normal, the rotary side of the trunk would be grounded but for the fact that relay *C* has reversed the trunk, throwing this ground on the vertical wire instead, ringing the subscriber. The impulse wire from relay *A* is disconnected for the prevention of false rings and local supervision by means of relay *D* and lamp No. 2 and the release at

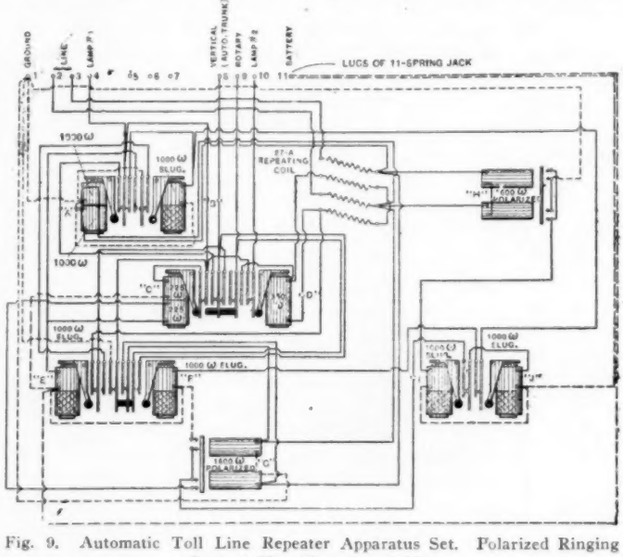

Fig. 9. Automatic Toll Line Repeater Apparatus Set. Polarized Ringing Control (See Figs. 8 and 10).

the termination of the call, are all accomplished in the same manner as shown in Fig. 7, and need not be detailed again.

In guarding against grounded ringing ,it was found that on account of the extreme sensitiveness of relay *G* (Fig. 9) to such disturbances it was necessary to bridge polarized relay *H* across the inner terminals of the repeating coil and wire it in such a manner that any ringing currents from the line would vibrate its armature, actuating relay *I* and disconnecting the set from ground.

preventing the abnormal currents from causing any trouble. In Fig. 7, it will be observed, a single polarized relay was sufficient for this, and the additional relay *I* (Fig. 9) was only added after it was found advisable for the sake of additional positiveness of action.

It will be observed that any accidental ground on the line will not cause a permanent "off normal," as is the case of local lines in the "three-wire" system, since the

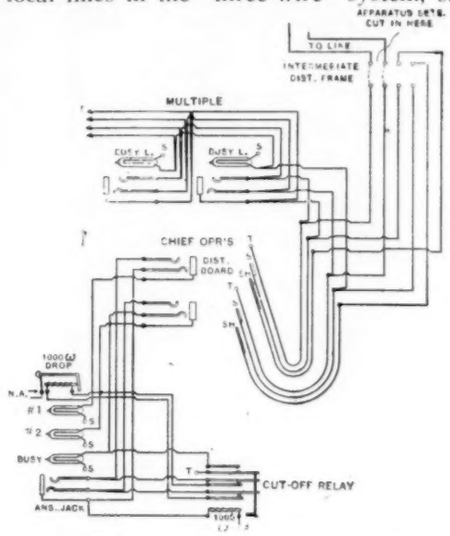

Fig. 10. Office Line Circuit at Portland and Tacoma.

automatic apparatus in the local exchange returns to normal upon the ground clearing, by means of a release action in the apparatus set. This is particularly fortunate, since long, exposed toll lines are always subject to accidental contacts of this nature.

One valuable feature in these repeaters is that any number of stations on the line may be equipped with automatic calling devices, or the more important ones may be thus equipped, and the rest allowed to operate on the line in the normal way only. Thus the ordinary operation and efficiency of the line is not affected, the automatic feature being simply an added convenience and time saver to the stations employing it.

The toll operator endeavors to check closely and time all switches called directly by automatic means by the distant operator, but in the event of heavy traffic on other lines under her care, can ignore the automatic lines and still not lower the standard of service to patrons, as no calls are retarded and the distant operator at the calling office is led to assume that her operating is being constantly supervised.

A vital condition manifesting itself in long distance automatic operation, which does not occur in local automatic operation, is that to insure quite long distance lines it is necessary to introduce a repeating coil in the circuit between the long distance line and the local automatic equipment, that is, in the apparatus set. Also, to insure that impulses from the long lines shall be of the character to properly actuate the apparatus in the local automatic exchange, some method of adapting such impulses coming from the long lines to the adjustment used for the short local lines must be provided. This is done in the repeater relays contained in the apparatus set. It is found in practice that permanent adjustments can be made so that changes are rarely necessary, even for great differences in line leakage—such as from dry to heavy weather.

The longest line equipped for automatic operation is from Corvallis to Portland, via Albany, a distance of 96 miles (154 km.) Albany also obtains automatic service over the same line to Portland. The line is No. 8 B. & S. copper to Albany, a distance of 84 miles (135 km.) and is No. 12 B. & S. copper from Albany to Corvallis, a distance of 12 miles (19 km.).

In the circuits used, both limbs of the line have been reserved for signaling and controlling the various circuit changes. However, the circuits have been designed to admit of ready change so that only one limb of the line would suffice, allowing the remaining limb to be used for telegraphic service if desired. Modifications may be made to permit the operation of phantom circuits as well.

At Portland and Tacoma a distributing board (Fig. 10) is provided for the convenience of the chief operator, permitting the answering jacks to be rearranged for night switching or for the distribution of traffic the lines on the multiples remaining permanent.

Supplementing the automatic and remote control methods in connection with toll lines, conveniences have been provided to facilitate the general operating as far as possible so that the least manual effort is required in handling traffic. Such saving not only conserves the operator's time, and speeds up switching and service, but it greatly conserves the time of toll lines—the operating company's only stock in trade. At Portland and at Tacoma, the company's largest offices, call wires are provided from all operator's positions to all operator's positions. Listening keys cut off all listening keys on the cord sets ahead, so it is impossible to cut two conversations together by accidentally getting two listening keys thrown, and thus demands less attention and care on the part of operators. At the right of the cord listening keys is the supervisory key with a position call wire lamp associated therewith, the relay actuating the lamp being mounted on the under side of the keyshelf, so that the closing of it will make enough noise to quickly attract the attention of the operator to the signal. Should the called operator be listening to a conversation at the time, she throws the supervisory key cam to the front position, which places her in connection with her call wire, cutting off the cord listening keys, and when through she returns it to the center position, when she is again supervising the cord conversation—the cord listening keys not having been disturbed. The rear position of the supervisory key allows unobstructed listening and talking. The center or supervisory position of the key short circuits the secondary of the operator's telephone induction coil and cuts in a 3,000-ohm non-inductive resistance. Non-inductive resistance is used in lieu of inductive resistance, since the speech may be further attenuated without rendering it unintelligible. It is not necessary to restore a listening key on a conversation should an operator desire to converse with another local toll operator—she simply depresses the corresponding order button, the cord listening keys being cut off by a relay before she gets the order wire connection; this operation being effective regardless of the position of the supervisory key. All supervisory circuits are so designed that no noise is discernible to correspondents on whom an operator may be listening, by any manipulation of the supervisory key or order buttons. Operators can listen on front or rear cords independently, and that without first restoring the regular cord listening key of the set; that is, the cords can be cut in both directions with the normal listening key thrown to the listening position.

Reliability of action has been a first consideration

in devising the equipment described. Although a circuit in which a number of functions are combined in one relay may look simpler in the circuit diagram, and may even have a lesser first cost, by providing several relays with simpler and more positive action, the reliability of the apparatus may often be increased and maintenance reduced.

In dealing with local exchange equipment the increased first cost due to elaborate equipment would be a fatal condition where the revenue per line is comparatively small, but where long and heavy copper circuits on expensive construction, and the time of operators is concerned, the revenue running to several dollars per hour, the first cost of an apparatus set constructed on apparently extravagant lines is a comparatively insignificant percentage of the total investment. To put it differently, if an expenditure of ten thousand dollars on a toll line is justified by the traffic offered, each one per cent of gain in efficiency should warrant an extra expenditure of one per cent of ten thousand dollars, or one hundred dollars, which exceeds the total cost of the most expensive of the line equipments described. Consequently, the use of automatic apparatus whereby any appreciable improvement in service is obtained is in every way consistent with attaining the highest commercial efficiency of the plant.

Checks and Bank Accounts

By Walter K. Towers

JOHN McGEE owed Warren Gordon five dollars for a couple of loads of cordwood. Gordon, having delivered the wood at McGee's residence, went to McGee's store to secure his money. McGee drew out his check book and signed a check in the usual form, instructing his bank to pay to Gordon the sum of five dollars. This was on Tuesday afternoon about two o'clock. The bank did not close until four, but Gordon, knowing that McGee was a responsible man of means and not needing the cash at that time, decided he wouldn't cash the check at once, but would keep it until he needed money at the end of the week. Wednesday passed with the bank open for business in the usual way, but again Gordon did not present the check for payment. On Thursday Gordon heard rumors that the bank was in difficulties and might fail, so he hastened to its doors only to find that he was too late and that they had already been closed. The failure proved complete.

Gordon went to McGee and asked that he be paid his five dollars, insisting that it was McGee's bank that had failed and that he had never received his pay for the wood delivered. McGee inquired into all the circumstances and pointed out that had Gordon presented the check for payment on either Tuesday afternoon or any time Wednesday it would have been paid in full. McGee further stated that he had had the money on deposit in the bank and it had been lost. Had Gordon presented the check within a reasonable time five dollars, at least, would have been saved, and there was no reason why McGee should lose the five dollars a second time. Before the law McGee's position was correct, he was not required to make good the check, Gordon having failed to present it for payment when he reasonably might have at a time when it would have been paid in full.

The payment of obligations by checks on bank accounts is a familiar business procedure in every community, and an examination of the legal relations of the banker, the depositor who signs the check and the person to whom he gives it, is of the greatest practical importance. Let us examine the legal significance of a check, the requirements of a good check and the obligations of the various parties to it.

The form of a bank check is familiar enough to all of us. It is usually prepared by filling in ink or pencil blank spaces in the printed form provided by the bank. But the entire check may be written, and checks have been prepared on many substances besides paper. Lumbermen have whittled out a smooth shingle and written their checks thereon. A young profligate in jail after a spree once tore off his cuff and wrote on it a check to obtain funds to secure his release. The requirement is that the check be in writing of some kind, which includes typewriting, etc. It is addressed to a stated bank, which is directed to "Pay to the order of John Jones," or "Pay to the order of Bearer," a certain sum of money. These words, "pay to the order of," are necessary to the negotiability of the check—that is necessary so that it may fulfill all the legal requirements and be capable of passing by indorsement, etc. A check may be drawn to "Bills Payable," or "Rent," or "Cash," and is then payable to bearer.

There is no legal requirement that a check be dated, but this is a wise and almost invariable custom. Any legal holder of a check may fill in the true date where it has been left blank. A check may be dated in the past, or in the future. If dated in the past it is payable at once, and if dated in the future it is payable on or after its date. While the words "on demand" are not used in a check, they are implied in law, the understanding being that the bank is instructed by the depositor to pay to the order of John Jones on demand.

A check must be signed by the depositor and usually in his own hand, though contract relations between bank and depositor may authorize the use of a rubber stamp, or some such device in place of a written signature.

In law the person who draws a check and gives it to another is understood to agree that he will stand back of the check and see to it that the person receiving it secures the money for which it calls, provided he handles it in a proper and reasonable manner. If the person receiving a check presents it to the bank within a reasonable time and the bank dishonors the check, and he then gives notice of this to the person who drew it, that drawer is bound to pay to him the amount of the check. A check should be presented during business hours by a person entitled to receive money on it on the next business day after receipt, at the latest. As we noticed in the case of John McGee and Warren Gordon, if the check is not presented within this time, and the bank fails, the loss must fall upon the person who failed to present it. But if the depositor suffer no loss because of the delay in presenting the check he cannot escape liability if it is dishonored. Thus if Warren Gordon had carelessly kept McGee's check several days

before presenting it for payment and in the meantime McGee had withdrawn his account from the bank, there being no failure, McGee would have been bound to see that Gordon received the amount of the check.

If a check is received drawn upon a bank in another city it cannot, of course, be presented for payment on that or the next business day, so it is sufficient if the check is put in course of collection on the business day following its receipt. One should be as prompt in giving notice to the drawer of the refusal of the bank to pay a check as to put it in course of collection.

A check that is drawn payable to "Bearer" may be transferred simply by delivery, handing it from one to another. If the check is drawn payable to "John Jones," John Jones may transfer it by indorsement—that is, by writing his name on the back. If he indorses in blank he simply writes his name "John Jones" across the end of the back of the check when it is payable to anyone who may hold it. If John Jones should write, "Pay to the order of Sam Smith, John Jones," Sam Smith alone would then have the right to present it for payment or transfer it by further indorsement. The blank indorsement of the person presenting the check at the bank is, of course, sufficient to transfer the legal rights in the check to the bank.

One who takes a check from another usually requires that he indorse it even though it be already indorsed in blank or payable to bearer. This is because the person who indorses a check to another is understood in law to make certain promises to the person to whom he indorses the check even though he does nothing further than write his name on the check. The indorser engages that when the check is properly presented at the bank it will be paid, and if it is not paid and notice is given to him he will pay the amount to the person to whom he transferred the check or any other who may subsequently receive it by proper indorsement. Thus when you indorse a check you make that promise to all future holders of the check. If you are compelled to make it good you may have recourse in turning against those who transferred the check to you and whose names appear on the back as endorsers, or on the face as signers.

While the bank owes a duty to depositor to pay his proper check drawn against an adequate deposit, the banker is not bound to pay any check as against a holder of it. The rights of the holder are against the signer of the check, and those who transfered it to him. But if a bank certifies a check it becomes bound to pay it to a proper holder. Certification of a check is secured by presenting it to the cashier of the bank against which it is drawn. Upon determining that the signer has funds sufficient to cover the check on deposit, and seeing to it that they are set aside for that purpose, the cashier marks "Certified" across the face of the check and adds his official signature. The funds to cover this check are then withdrawn from the control of the depositor who signed the check and he may not stop payment of it, or withdraw the funds to cover it. The bank becomes absolutely bound to pay it, and the check is as good as the bank. Usually the person who signs a check has it certified in order that one to whom he would give it in payment of an obligation will be more ready to receive it. His liabilities on the check remain the same if he has it certified. But if one who holds the check, other than the person who drew it, has it certified, he then in effect says that he chooses to look to the bank for payment of the check, and the depositor who signed it and all who indorsed it before him are relieved from their liabilities, the bank alone becoming liable to the holder.

If an ordinary check comes to you the safe procedure is to either present it to the bank on which it is drawn and secure the cash, or to deposit it in your own bank for collection, and do this within twenty-four hours after it is received, or at least on the next business day. It may seem immediately convenient to turn another's check over to a third party, but if you do so recognize the risks involved. The safe procedure is to cash the check you have and pay the third party by your own personal check on your own account or with the cash received.

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An Ocean Telephone

On May 1 what is probably the first ocean telephone call station was opened for public use, says the London *Electrician*. This is in Platte Fougère lighthouse on a rock lying about 1¼ miles to the northeast of Guernsey, Channel Islands. The lighthouse, which has no keeper, is fitted with a powerful fog signal, worked from shore by means of a submarine cable. In a fog, ships creep up guided by the fog horn and drop anchor near the lighthouse until the fog lifts sufficiently to enable them to take the narrow channel to the harbors of Guernsey. In such case any pilot or ship's officer by climbing the lighthouse can ring up Guernsey telephone exchange and report his ship. The telephone is reached by climbing a 42-rung ladder to the platform outside the lighthouse doors. Before he can leave the ladder the pilot pushes open a trap door which covers the manhole in the platform. The arrangement is such that the pilot cannot open the lighthouse door to reach the telephone until he has shut down the trap door over the manhole. The act of opening the outer lighthouse door connects the telephone fitted outside the inner door of the lighthouse, which is kept locked. Only one wire in the cable is available for the telephone, and even this wire is required for other purposes, and closing the door after using the telephone connects up several tell-tale devices. The lighthouse door cannot be left open by forgetfulness because the pilot must close it before he is able to lift the trap door in order to reach the ladder.

Competition Threatened in Nebraska

At a meeting of the East Lincoln (Nebr.) Progressive League the telephone question was brought up. A resolution made at the meeting follows:

Whereas, the telephone rate hearing before the Nebraska State Railway Commission resulting in an order permitting the telephone company to raise its rates upon a valuation which the general public believe to be excessive and unjust, thereby causing general dissatisfaction with the decision of the commission and,

Whereas, The legislature at its last session passed an act permitting county ownership of telephone systems, under the supervision of the county commissioners. Therefore be it

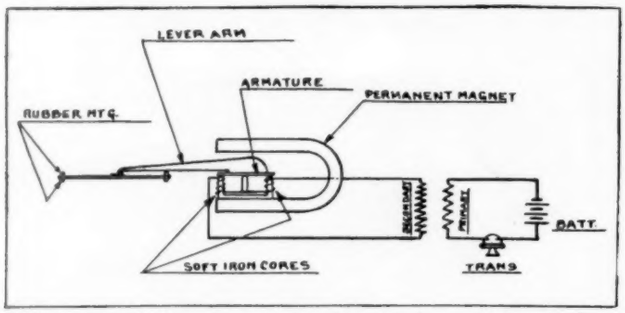
Resolved by the people here assembled, that the county commissioners of Lancaster county, Nebraska, be, and they are, hereby respectfully petitioned to employ a competent electrical engineer from the Bion J. Arnold Electrical Engineering Company, or an engineer of similar responsibility, to prepare plans and estimates of the cost of establishing a complete telephone system for Lancaster county, including both cities and country. And be it further

Resolved, That the county commissioners be furnished a copy of this resolution signed by the president and secretary of this meeting.

The Telephone Scrap Book

How the Loud Speaking Telephone Works

LOUD speaking telephones have become quite a commonplace thing of late, and it may be interesting to see just how they produce their results. It is comparatively simple to obtain either volume or articulation, but difficult to insure both. It is largely a question of current carrying capacity and, of course, efficiency.



Diagrammatic view of the loud-speaking telephone, showing the lever connection to the receiver diaphragm.

The quality and articulation are largely dependent upon the mechanical dimensions of the diaphragm and the manner in which it is mounted. In any diaphragm a certain tone will be found which is fundamental to it; and as the weight of the moving part which is attached to the diaphragm is increased, this tone becomes emphasized. If the moving mass is not kept exceedingly small, this tone interferes with the proper reproduction of the words transmitted.

The problem of designing an efficient transmitter for this service has, therefore, been that of making use of the largest possible mechanical proportions in order to permit of large currents, without making the moving parts too great in mass to destroy distinctiveness of articulation.

The one particular point followed in the design of the loud-speaking apparatus has been the obtaining of a method of construction which will give greater emphasis to the harmonics of the voice and less to the fundamental note. In general, this method will give far better results as far as intelligibility is concerned. This principle has been followed out consistently in the construction of both the transmitter and receiver used in the loud-speaking combination.

As in the case of the transmitter, the articulation of the receiver is governed largely by the mechanical characteristics of the diaphragm and the method in which it is mounted. In the receiver, the diaphragm has been corrugated and mounted on rubber cushions along the lines of phonograph construction. It was, however, found advisable to depart from one of the usual features of receiver construction and use a metal other than iron in the construction of the diaphragm. This was made possible by the use of an iron armature which would be acted upon by the pole pieces. Phosphor bronze was found to produce the best result from the standpoint of both volume and articulation and has, therefore, been used for the diaphragm. A lever arm connects the diaphragm to the armature.

By employing the magnetic principles used in the construction of polarized ringers, the efficiency of articulation was found to be still further increased. This fact may be accounted for by the resultant reduction in the inertia of the moving parts. The use of a differential magnetic circuit in the receiver has also made it possible to obtain a two-way positive action of the diaphragm. In the normal condition of the receiver the diaphragm is practically free from all tension. This has the effect of greatly increasing the efficiency of construction, due to the fact that a much smaller air-gap may be used.

These new and entirely original constructive features have produced a loud-speaking telephone which combines clear articulation with a maximum of sound volume.

MERCURY ARC RECTIFIERS FOR CHARGING TELEPHONE

THE use of motor generators and similar rectifiers is comparatively expensive for smaller exchanges. The mercury arc rectifier on the other hand is reliable, non-sensitive to changes in tension in the wires, has low cost of installation and operation, and other advantages that need not be mentioned in detail. The little space it needs also recommends it, so that it can even be placed near the switchboards, if the exchange is cramped for space. The efficiency of the rectifiers depends to a large extent on the tension used for charging the batteries. The installation costs do not rise in proportion with the tension, so that two or more batteries can be charged when placed in series. With a d.c. tension of 30 volts the rectifier has a high efficiency and retains this efficiency no matter whether running under full load or under partial load. The efficiency of such a rectifier is about 57 per cent independent of the current capacity. If charging a battery of 17 cells, this efficiency rises to 67

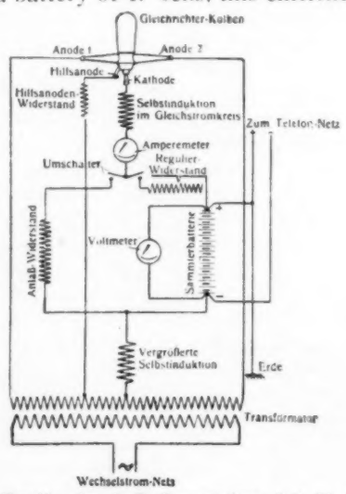


Fig. 1. Rectifier for A. C. Current from 5 to 10 Amperes.

per cent, with 40 cells to 80 per cent, with 84 cells to 85 per cent. Mercury arc rectifiers are built up to 220 volts d.c. and 40 amperes. Any number of them can of course be placed in parallel on one switchboard, thus obtaining a high charging current. Figs. 1 and 2 show the wiring diagrams for charging telephone batteries when running in parallel operation. Characteristic for parallel operation is the use of increased self induction in the d.c. circuit and of transformers with insulated windings. A choke coil is placed in series between the cathode and the

positive pole of the storage battery. It is the duty of this coil to control the pulsations of the rectified d.c., so that the lowest value shall not pass beyond a minimum limit at which the rectifier arc would go out. In addition the apparatus is to prevent troublesome noises that might occur in charging the batteries during the day when the telephones are used. This effect is obtained through increasing the self induction in the d.c. current. Tests have shown that rectifiers thus equipped cause no noises in the receiver so that operation can go on while charging batteries. The cross section of the windings of these self

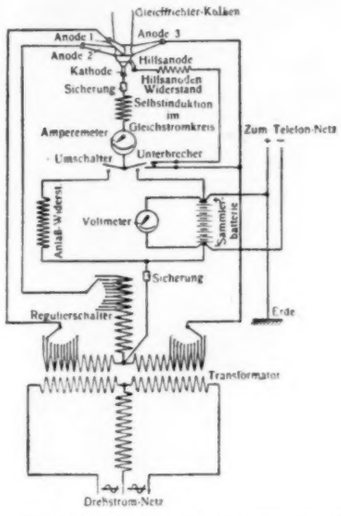


Fig. 2. Rectifier for A. C. Current with Inductive Regulation Above 10 Amperes.

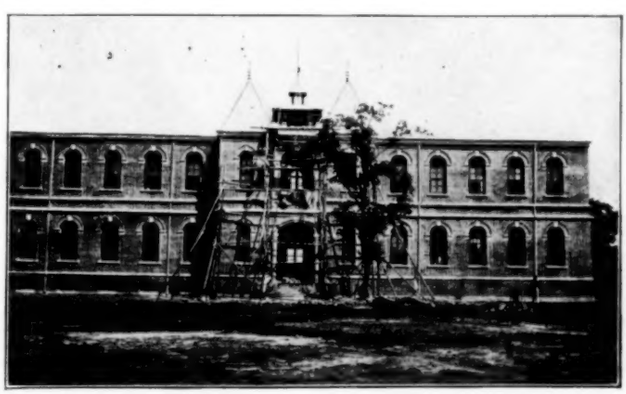
inductances is estimated so that the losses in the coil shall not influence the efficiency of the rectifiers. If the exchange has two sets of storage batteries, so that one set can be charged while the other supplies current for the exchange, no increased self induction is necessary. With a.c. rectifiers this induction can be left out entirely. According to practice followed by most exchanges, the neutral points of the transformers are grounded. The storage batteries are usually grounded on the positive side. If the rectifier were to work with an auto-transformer, a short circuit would result in the glass of the rectifier as soon as the mercury arc is lighted, as the diagram in Fig. 1 shows. To avoid this, it has been necessary to eliminate the grounding on the a.c. side by using a transformer with insulated windings. The insulation of the two windings is made with great care to avoid all passing of current through faulty insulation. The regulation of the charging current tension is obtained in all rectifiers up to 10 amperes d.c. with the aid of resistances. With higher current rectifiers inductive regulation is used, thereby avoiding all energy losses.—*Elek. U. Masch.*

By the end of August, 1913, the Société Anonyme Ottomane des Téléphones de Constantinople hopes to have its service inaugurated. Thirty persons comprise the technical staff which is engaged in supervising its lines, and the company has about 5,000 kilometers (3,100 miles) of cable, 3,000 kilometers (1,860 miles) of underground wire and 30,000 kilometers (18,600 miles) of duct already placed. Subscriptions for 2,101 stations have been received and 22 per cent of the subscribers are purely Turkish.

Telephone Development in China

BUSINESS competition is very keen and the Chinese are exceptionally close buyers, says H. D. B. Moore in the *Western Electric News*. In the purchase of foreign machinery they are at somewhat of a disadvantage, however, having very little technical knowledge. The average Chinese customer usually does not see why, for instance, one telephone is not as good as another telephone. He cannot see why one telephone may cost $20 and another telephone may cost $10, and merely thinks any explanation is only a scheme to get him to pay more money. All he knows is that he wants a telephone. Many things which are self-evident to the foreigner seem to be quite beyond the comprehension of the average Chinese customer.

The present telephone development in China is not very large. The Western Electric Company, three years ago, installed two up-to-date No. 1 common battery switchboards in Peking. Each switchboard is at present equipped for 1,500 subscribers' lines, with a capacity for 6,000. Recently the company has secured contract for a common battery telephone exchange to be installed in Tientsin with a present equipment of 4,000 subscribers' lines and a capacity of 14,000 lines. Shanghai has a large telephone exchange but the switchboard is of the magneto calling lamp signal type. There is also a fairly modern switchboard in Hong Kong, of the magneto multiple type. Outside of these places, telephone exchanges in China are few and far between. Most of them consist of the standard European type 100-line magneto switchboards. Very few cities have a telephone exchange with as many as 500 subscribers and the average telephone exchange in China has less than 200. Still, China is changing very rapidly, and as the Chinese are eminently practical people they are beginning to realize the importance of telephones, a circumstance promising a steadily increasing development.



The New Telephone Exchange at Peking.

The Western Electric Company has recently received an order from the Chinese government for a complete telephone equipment for Tientsin, including switchboard, cable and subscribers' sets. The switchboard will have an ultimate capacity of 14,000 lines, equipped at present for 4,000 lines. The value of the order is over a quarter of a million dollars, and is the second large contract which has been placed for modern telephones in China. Both of these contracts were secured after the keenest kind of competition with foreign makers.

Two small exchanges have recently been shipped for installation in Tsinanfu.

Cross-Arm and Pin Protector

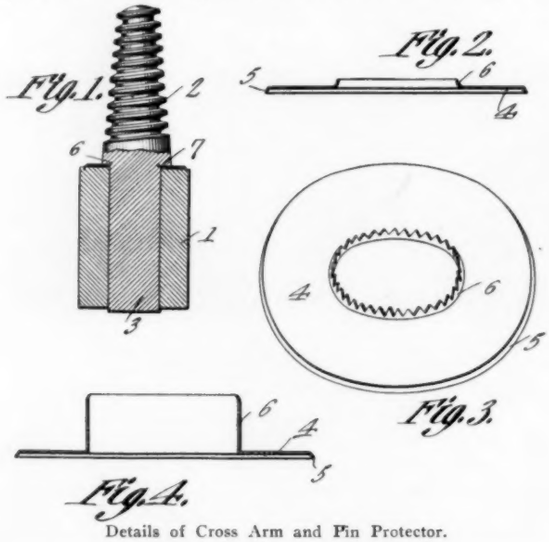
INDIRECT losses from line troubles and direct losses through repair expense on decayed pins and cross-arms, amount to a considerable item. Telephone men, therefore, will be interested in a cross-arm and pin protector recently devised and patented by Henry G. Newell of the People's Consolidated Telephone Company, Rome, Pa. The invention is a device for preventing water from entering into the joint between the cross arm of a telegraph pole and the pins which are mounted thereon. By thus preventing moisture from getting into the said joints it is found that the life of these members is greatly increased.

Fig. 1 is a cross sectional view of a cross arm and pin, with the improved protector attached. Fig. 2 is a side view of the protector. Fig. 3 is a perspective view of the same. Fig. 4 is a slightly modified form of the protector.

In the drawing, *1* is a wooden cross arm such as is commonly used on telegraph and telephone poles, a wooden pin *2* being shown connected thereto and having the usually lowered portion *3* extending down into a hole in the cross arm, all of which is of the usual form and construction.

The protector as shown in Fig. 1, is placed between the shoulder of pin *7* and the upper surface of the cross arm and consists of a flat thin body portion *4*, around the outer edge of which is the downwardly extending flange *5*, said flange terminating in a knife-like or saw-tooth edge so that the flange may be readily driven into the wooden cross arm as shown in Fig. 1. The body portion *4* is provided at its inner edge with an annular upturned flange *6* which flange has at its extremity a knife-like edge which may also be serrated as shown in Fig. 3. By thus constructing the flange *6*, it is readily driven into the wooden pin *2*.

A somewhat modified form of protector is shown in Fig. 4, in which the flange *6* is somewhat elongated and is adapted to fit over the pin *2*. Its extreme edge is adapted to be bent against and driven into the pin.



Details of Cross Arm and Pin Protector.

By the use of this protector, water and moisture is prevented from entering between the pin and cross arm, thereby preventing the premature decay of both pin and cross arm and lengthening the life of each at its most vulnerable point.

Telephone Is a Life Saver

IN the estimation of the general public, the telephone is merely one of the little wheels of our complex social and industrial machinery. So unobtrusively does it perform its arduous task of saving labor, eliminating

The Telephone That Stopped a Bullet.

time and distance and establishing and maintaining feelings of kinship between widely separated communities, that we accept its services without any conscious sense of appreciation. Occasionally some phase of the telephone business commands special attention, but the individual telephone set rarely gets more than a passing thought—except from the trouble man or some irate subscriber.

Here is an exception, recorded by the *Western Electric News*. In a single instant this telephone sprang—figuratively speaking—from its niche of obscurity into the full glare of the lime light. It stopped a 44 caliber bullet, and down in the hill country of Virginia—where the incident occurred—that means something.

This near-tragedy occurred in a pawn shop in Roanoke, Va., and is vouched for by N. O. Wood, general manager of the Virginia-Tennessee Telephone and Telegraph Company. A customer, coming in to pawn a pistol, passed it, butt foremost, to the pawnbroker with the assurance that it was unloaded. Without changing the position of the weapon, "Uncle" casually pulled the trigger, discharging a cartridge that had been overlooked. If the desk stand had been sitting an inch nearer the end of the show case, one more human life would have been added to the ever-lengthening story of the "didn't-know-it-was-loaded" gun.

The automatic exchange installed at Geelong, Victoria, Australia, has proved a success, and the government has now intimated that it intends to install similar exchanges at Balmain, Newtown and Glebe, in this state; at Perth, in Western Australia; and at Brighton, in Victoria. Altogether these and other outstanding tenders will run into about $1,000,000.

Trunk Schemes and Circuit Design

By A. B. Hart and W. J. Hilyer*

THE history of long-distance telephony in the United Kingdom commences with the inauguration of the London-Paris lines in 1891. Subsequent to 1891 the postoffice engineers were engaged in designing and constructing what has been known as the Backbone trunk system. Most of the lines were completed and working in 1895, and when in 1896 the postoffice acquired the trunk lines operated by the National Telephone Company, the nucleus of a comprehensive trunk service covering the whole country was formed. The efficiency of the Backbone lines was of the highest grade. Copper conductors weighing 1,600 pounds per loop mile were used for the longest and most important circuits—such as the London-Glasgow, London-Leeds, Leeds-Belfast and Belfast-Dublin circuits. Conductors weighing 1,200 pounds per loop mile were used for the secondary circuits, such as the Cardiff-Birmingham, Birmingham-Newcastle, and Liverpool-Glasgow trunks; while for circuits such as London-Ipswich, London-Brighton, London-Bristol conductors of 800 pounds per loop mile were erected. The Backbone trunks were erected as aerial lines throughout. Viewed in the light of our present day knowledge and experience, the trunk system thus formed was defective in some respects.

Probably the most important point to decide before a transmission scheme can be worked out is the quality of speech to be provided for the class of service under consideration. It has been stated by writers in the journals of the American Institute of Electrical Engineers that the quality of speech provided for local communication is equal to that afforded by two standard telephone sets separated by 25 miles of standard cable, and that the standard quality of speech for long-distance communications is equivalent to that obtained between two standard telephones separated by 30 miles of standard cable.

Mr. Martin tells us that he learned during his recent visit to Germany that 30 miles of standard cable is regarded as the greatest equivalent which should be allowed between any two subscribers for a long-distance talk, of which equivalent not more than 25 miles should be allowed in the trunk line.

In deciding upon the standards to be adopted for the various classes of telephone calls, due regard must be given to the conditions under which a subscriber may be reasonably expected to use his telephone—for instance, for local talks a subscriber may reasonably expect to be able to carry on a comfortable conversation in an ordinary office into which street noises, etc., penetrate; and for trunk talks to towns up to 200 miles distant it is perhaps not unreasonable that the subscriber should expect to be able to carry on a conversation in an ordinarily quiet room; but for extra long-distance talks—continental communication, for instance—it is necessary that the subscriber should provide himself with a silence booth or a room made sound-proof. If these propositions are accepted, the general experience is that commercial requirements for local service can be met by a standard not worse than 25 miles of standard cable; and that for ordinary trunk service a standard of not worse than 30 miles of standard cable can be allowed; whereas for extra long-distance talks it is often necessary to speak over lines having a standard cable equivalent approaching the limit of commercial speech. The standards intended to be recognized in this country have, it is feared, in the past been misinterpreted, and what was accepted as a limiting value has come to be regarded as a standard for general application, with the unfortunate result that communication between many points not very widely separated geographically is very difficult except under the most favorable conditions of lines and apparatus. Several causes have led up to this result, and some of them will be referred to.

It will be well to investigate certain formulæ which have been developed as aids in determining the best distribution of copper for any telephone system. The laws for aerial and underground systems respectively differ considerably.

Taking first the case of an aerial system of line construction. If a curve be plotted showing the relationship between weight and efficiency for open wire, it will be found that it obeys the law

$$E = \frac{5}{W^{0.82}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where E is the equated length per mile of loop the single wire weight of which is W.

Let an efficiency expressed as S standard miles be required between a zone center and any of a number of local exchanges working on a junction center. If L be the length and N the number of the trunks between the zone center and the junction center; l and n the average length and number respectively of the junctions; E the economic equivalent for the trunks and e that for the junctions—then

$$LE + le = S \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

and regarding the value of pole space as constant for the smaller gauges of wire (say $35 per mile of loop), we have

$$\frac{2x\ (N \times L \times W + n \times l \times w)}{2{,}240} + 35\ (NL + nl) = \text{cost} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where x is the price of copper per ton, and W and w are the single wire weights of trunk and junction conductors respectively.

But from (1) $$W = (5/E)^{1.22} = \frac{7{\cdot}12}{E^{1.22}}$$

and $$w = \frac{7{\cdot}12}{e^{1.22}}$$

Substituting these values

$$\frac{2x}{2{,}240} \times 7{\cdot}12\left(\frac{NL}{E^{1.22}} + \frac{nl}{e^{1.22}}\right) + 35\ (NL + nl) = cost.$$

and since $$e = \frac{S - LE}{l} \text{ from (2),}$$

we have $$\frac{NL}{E^{1.22}} + \frac{nl^{2.22}}{(S - LE)^{1.22}} + 35\ (NL + nl) = \text{cost.}$$

*Abstract of a paper read before the (British) Institution of Post Office Electrical Engineers.

By the usual differential method we find the minimum cost when

$$E = \frac{S}{l\left(\frac{E}{N}\right)0{\cdot}45 + L} \quad \ldots\ldots\ldots (4)$$

Having ascertained this value for E, the nearest standard weight can be ascertained from the efficiency-weight curve; e, of course, will be determined by the value $\frac{S - LE}{l}$.

Considering the case of a junction center T serving several local exchanges A, B, C, D, etc., it is desired to determine the best distribution of copper between incoming and outgoing junctions radiating from the junction center. Let it be assumed that the local exchanges are approximately equidistant from the junction center T.

Let N represent the number of outgoing junctions required for through traffic and n the number of incoming junctions.

Let l be the average length of the junctions.

K is a constant, the value of which will be explained later.

y^2 the weight of the outgoing junctions per mile.

Then $$y^2 = \left(\frac{\sqrt[3]{(n/N)\, l + l}}{K}\right)^2 \quad \ldots\ldots\ldots (5)$$

The ratio n/N will, of course, be determined by the ratio of A to B traffic.

It is necessary to state here that for purposes of comparative economic investigation it is necessary to assume that a 3-inch cable is drawn into a 3¼-inch duct, and that for any size of conductor the cable is filled with copper to the same extent. We take 100-pound to 150-pound conductors as a standard and assume the same total amount of copper in the sheath for all other sizes; if this be not done—and the process is quite legitimate—the formulæ become unwieldy. With this assumption we calculate that the wire-to-wire electrostatic capacity will be 0·065 microfarad per mile for each size of conductor within very narrow limits; β, the real part of the attenuation constant for underground conductors, may thus be written as

$$\sqrt{\tfrac{1}{2} \times 5{,}000 \times 0{\cdot}065 \times R \times 10^3} \quad \ldots\ldots\ldots (6)$$

where R is the resistance per loop mile; this may be rewritten $\frac{0{\cdot}534}{\sqrt{w}}$ where w is the weight of conductor per mile of single wire. It follows that the equated length of 1 mile of underground wire weighing w pound per mile is $\frac{0{\cdot}534}{0{\cdot}106} \times \frac{1}{\sqrt{w}}$; and K in the formula (5) is the product of the allowable equated length of junctions and $\frac{0{\cdot}106}{0{\cdot}534}$.

LOADING.

The formula generally accepted for the calculation of (β) of a loaded underground cable is

$$\beta = \frac{R + (S/K)\, L}{2}\sqrt{\frac{K}{L}} \quad \ldots\ldots\ldots (7)$$

where R is the total loop resistance of the line and coils in ohms; S the leakance at 800 p.p.s. in ohms and K the wire-to-wire electrostatic capacity of the line in farads; and L is the inductance per mile of circuit in henries (including both the coil inductance and the inherent inductance of the line). This formula can be written

$$\beta = \frac{R_1 + \left(\frac{r}{l} + \frac{S}{K}\right) L_2 + \frac{S}{K} L_1}{2}\sqrt{\frac{K}{L_1 + L_2}} \quad \ldots\ldots\ldots (8)$$

where R_1 is the loop resistance of the line, r is the effective resistance of the coil at 800 p.p.s., and l its total inductance; L_1 is the inherent inductance of the line and L_2 is the inductance per mile due to the coil.

It is obvious that both the ratios r/l and S/K have a degrading effect on speech and consequently any reduction in their value is to be welcomed. An iron-core which has a ratio r/l of 50 has hitherto been used by the post-office. Coils having ratios of 25 and 32 are now obtainable, but their cost is comparatively high and the occasions on which their use is justified economically are rare.

The value of S/K which has hitherto been used in calculating the value of the attenuation constant of underground loops when loaded with iron-core coils is 80; this value is based on a series of experiments made some years ago by Messrs. Martin and Hill. Prof. Fleming and Mr. Dyke in their paper "On the Power Factor and Conductivity of Dielectrics When Tested with Alternating Electric Currents of Telephone Frequency at Various temperatures," read before the Institution of Electrical Engineers in March of last year gave the value of S/K for a cable which they tested as about 20. The magnitude of S/K depends much upon the care taken in manufacture and in jointing; the cost involved in obtaining the lower figure is not high and the matter certainly deserves the careful attention which it is now receiving. In dealing with the provision of new loaded cable after the efficiency required has been ascertained it is necessary for the circuit designer to determine the cheapest method by which the required efficiency can be obtained. A fixed standard cable equivalent can generally be obtained by various combinations of inductance and resistance.

When a certain standard of efficiency can be obtained for the same cost by using:

(1) Heavier conductors or lighter loading or loading with the cheaper kind of coil.

(2) Lighter conductors and heavier loading or loading with the dearer type of coil.

We prefer (1), since it gives a higher residual value of plant than does (2). For underground cables the postoffice has hitherto confined itself, excepting as regards a number of experimental circuits, to what is termed "light" loading—that is loading to the extent of from 0·05 to 0·06 henries per mile. An increase in surge impedance and terminal loss of the circuit occurs as inductance is made greater. Consideration of this point and the experimental data at our disposal together with the fact that in the case of the heavier conductors a relatively large cost accompanies a small decrease in β has so far made it economical to adopt light loading as the standard in this country. The considerable extension in the use of long-distance loaded underground trunks which is likely to occur in the near future may, however, alter matters. With loaded lines of from 100 to 200 miles in length it may be desirable to utilize heavy loading over the middle sections, or to load heavily throughout and use specially designed transformers of unequal ratio of winding (terminal transformers) to reduce terminal losses; the latter possibility is more favorable when it is desired to form superposed circuits, and transformers

with their inherent losses must be used in any case. The value of the inductance when β begins to increase is that obtained from the formula.

$$L_2 = \frac{R + (S/K)\ L_1}{r/l + S/K} - 2L_1 \ldots\ldots\ldots (9)$$

which can be deduced easily from the equation

$$\beta = \frac{R + (S/K)\ L}{2}\sqrt{\frac{K}{L}}$$

and is the maximum amount of inductance which can be added to the line beneficially. The value of β at the same instant is $\sqrt{(R - (r/l)\ L_1)\ (r/l + S/K)\ K}$, and is the minimum obtainable with the particular circuit. The letters in these formulæ have the significance explained above.

Spacing, of course, always depends upon the particular length of the cable to be loaded, since it is necessary to arrange as nearly as is practicable that successive coils are placed at equi-distant points. With a wire-to-wire electrostatic capacity of 0·065 mfds., however, the standard spacing for a 133 m.h. coil may be taken as 2·5 miles (with terminal spaces of 1·25 miles). This gives 3·4 coils per wave length at frequency 2,000. The following table gives "standard" spacing and inductance per mile for the various types of coils for a cable having wire-to-wire capacity 0·065 mfds.:

	Inductance of coil: (henries).	Spacing: (miles).	Inductance per mile: (henries).
Extra light loading	0.060	5.55	0.011
Light loading	0.133	2.50	0.053
Medium loading	0.175	1.90	0.092
Heavy loading	0.250	1.33	0.188

When a cable has to be loaded, however, it is necessary to adopt a spacing which shall be as near as possible to 2·5 miles (assuming that the cable has a wire-to-wire capacity of 0·065 mfds., and is to be lightly loaded), and which shall be a sub-multiple of the total length of the cable. The terminal spaces, *i. e.*, the spaces between either end of the cable and the first coil from that end should be half the length of the space between successive coils.

While the cable is being laid up care must be taken that the designed length of lay of wires and pairs is maintained throughout. During the laying of the cable any want of uniformity in resistance or capacity (*i. e.*, capacity to the remaining wires of the cable and earth) must be balanced out by jointing suitable pairs in successive sections.

THE DESIGN OF A TRANSMISSION SCHEME.

The first step is to locate the theoretically correct positions of local exchanges and to define the boundaries of the exchange areas. The grouping of the local exchanges around junction centers must be next studied, and the area of the district served by the junction center defined. These districts will be similarly grouped around a trunking center or a zone center as we call it in the postoffice. The zone boundaries will be defined and finally grouped into provinces, in each of which a zone center will be selected as the province center. We have now to show how we can make the results of our fundamental transmission studies fit in with the practical requirements of the public service. We have suggested that the standard of speech volume to be provided for local or trunk communications should be 25 and 35 miles respectively.

THE SUBSCRIBER'S LINE.

This is the one link which in every case forms part of the train of connections between any one subscriber and another. When the subscriber's line is considered in conjunction with other plant, economic considerations give varying values of equated length depending upon the speech quality determined for the class of communications under review as the cheapest for the line. The efficiency of a common-battery subscriber's line does not vary directly as the resistance, but it may be taken that within practical limits any two subscribers' lines having the same resistance are of the same efficiency irrespective of the relative electrostatic capacities in the case of common-battery subscribers' lines, therefore, a ready and practical standard is one expressed in terms of ohmic resistance. With the local-battery subscriber the same condition does not hold, the efficiency of the line depending upon its attenuation constant; but any slight disadvantages which might accrue on account of the fact that resistance is not an accurate expression of efficiency is greatly outweighed by the advantages arising from uniformity of practice, especially as variations of only a mile or so of standard cable result. Consequently the standard is expressed in ohmic resistance for local battery, as well as on central-battery subscriber's lines. In large towns underground cables are generally in use for subscribers' lines; pipe space is precious, and economic investigations will show that the cheapest plan is to utilize light wires for subscribers' lines, reserving the heavy conductors for the much less numerous junctions and trunks. Apart altogether from transmission considerations, matters of construction limit the size of wires which can be used: the smallest size of underground wire used by the post-office for telephone work weighs 10 pounds per mile, whilst the smallest open wire (bronze) weighs 40 pounds per mile. These sizes are therefore assumed to be for our purpose the standards for subscribers' lines in cables and on open lines respectively.

Taking the resistance of 10-pound conductors per mile loop as 176 ohms and fixing the limiting resistance of a subscribers' loop as 350 ohms, we are able to reach subscribers within a radius of 2 miles from the exchange on 10-pound conductors. This radius will include the area served by local exchanges in all important towns. In the smaller towns and rural districts much of the subscribers' lines will be aerial and, therefore, of a resistance not greater than that of 40-pound bronze. Moreover, the distances reached by underground cables will be considerably shorter than in the large towns, and pipe space being of less value than in congested districts, heavier conductors can be utilized where necessary underground at a cost little above that of the actual copper. It is, therefore, possible to adopt for the smaller towns and rural districts a limit of resistance lower than that for the large towns, and 250 ohms may be found to be a suitable figure.

JUNCTION CIRCUIT EFFICIENCIES.

For the purpose of this paper the term junction includes any line between the two local exchanges, between a local exchange and a junction center, or between a junction center and a zone center. Where the total amount of traffic dealt with at a local exchange is small and can be accommodated on a very small number of junctions, say, three or four, it will generally be found advantageous to design those junctions so that they can

carry any traffic originating at or destined for the exchange under consideration.

Having fixed standards for subscribers' lines, economical considerations can be confined to the determination of the gauges to be used in the junctions. The efficiency of the junction will, therefore, be decided by the requirements of the province scheme for kingdom wide communication.

TRUNK CIRCUIT DESIGN.

The following axioms must be kept in view: (1) For a given efficiency the cheapest circuit is one which is homogeneous. (2) If for a stated standard cable equivalent the efficiency weight curve gives a size of conductor which is not standard then the cheapest circuit composed of standard conductors is one which contains only the standard sizes nearest on either side to the theoretically best. The amount required of each of these standard sizes can be determined by an easy calculation. These two rules can be verified by reference to the weight and cost efficiency curves for aerial and underground wires. (3) When a circuit is composed partly of aerial and partly of underground wires then it is economical to make the underground portion (especially if it be unloaded) of as high an efficiency as possible. A circuit can be improved by increasing the gauge of the underground portions at a much lower cost than would be involved in effecting an equal improvement by increasing the gauge of the open wires.

The efficiency-cost curve for open wires is much steeper than that for unloaded underground conductors, and also than that for loaded conductors so far as the sizes of loaded conductor which are most generally used on trunk lines are concerned. In designing long-distance circuits the most economical arrangement from a copper-cost point of view is to keep the circuits aerial throughout; but such an arrangement has hitherto been unattainable in this country. This inability has been due mainly to three causes: (1) The existing regulations in regard to maintenance testing. (2) The rooted objection of urban authorities and others to the presence of telegraph-pole lines in public roads and streets. (3) The increasing number of overhead electric power systems. For maintenance testing purposes the trunk lines are divided into sections by testing points situated about 12 miles apart, sometimes less, and test boxes where all the lines appear on terminals are fitted at each testing point. The theory which, we understand, is said to justify this practice is that the time taken to localize and remove line faults is reduced to a minimum, and consequently revenue earning time is kept at a minimum.

In connection with this point it may be well to draw attention to a formula which gives the ratio of the current leaving the underground cable to that which is oncoming at the other end, when the cable is extended by long lengths of open lines on either side. The formula is

$$\frac{I_b}{I_a} = \frac{4Z_oZ_o'}{(Z_o+Z'_o)^2ePL-(Z_o-Z_o')^2e-PL}$$

where I_b is the current leaving and I_a that oncoming, P is the propagation constant, Z_o the characteristic impedance of the open line and Z_o^1 that of the cable; and L length of the cable.

Of course, the formula applies to any heterogeneous circuit consisting of two long portions of impedance Z_o on either side of a shorter portion of impedance Z_o'.

We would suggest that the major trunk lines be divided as now into 12-mile sections, but the dividing points should be test-poles where the wires are terminated on specially designed insulators. The only "leads" on the pole should be a set of four wires provided with special terminating clips so arranged that any square of wires can be led down to a terminal box fitted, say, 6 feet above ground line. The testing and fault localizing offices should be spaced eight sections (that is about 100 miles) apart. The trunk lines should not, however, be permanently led into these offices unless they actually pass close by.

Occasions will still arise where short lengths of underground, a mile or thereabouts in length, will be unavoidable. In those cases careful consideration should be given to the possibilities of minimizing transmission losses by loading. Some differences of opinion exist as to efficiency of loading short lengths of underground cable in aerial-trunk circuits, but it will, we think, be generally agreed that much may be learned from actual trials. Steps have already been taken in this direction and the results of the trials will, it is hoped, be available shortly. The amount of inductance that is being inserted in the circuits selected for treatment is such as to bring up the characteristic impedance of the underground cable (regarding the same as uniformly loaded) as nearly as possible to the characteristic of the aerial sections on either side. A special type of loading coil is being used. It is made up for fixing on test frames or test boxes. The efficiency of a trunk service viewed from the standpoint of the commercial user is not to be measured in terms of standard miles only; that is to say, it is not only a question of volume of speech. The other important factors of efficiency are silent circuits and stability of service. In regard to the former, it must be realized that an amount of cross talk or inductive disturbance, which would not be noticed in a local line conversation might be sufficient to interfere seriously with conversation between two speakers using a long trunk line. By stability of service, we mean the continuity of promised facilities; or in other words, the absence of those disturbing factors which seem to result in a good and quick service one day and a bad and slow service the next. Freedom from cross-talk and inductive disturbance on aerial-circuit routes is obtained by the continuous twist system or by the cross-over system of wire erection. In either case it is essential that perfect regulation of the wires be maintained. Unfortunately, in this country the limitations imposed on aerial line construction frequently render perfect regulation of wires difficult to obtain; the difficulties increase with the load on the pole lines; and the periodical gales and snowstorms which are experienced, particularly in the northern districts, cause havoc which takes weeks to repair. On the score of quiet circuits and stability of service the underground loaded cable offers a great advantage over the aerial line; and when the cable can be proved in on the grounds of capital cost and transmission efficiency there should be no hesitation in providing it in preference to the aerial line. As a matter of fact it can be shown that for very heavy routes up to, say, 100 miles' length between busy towns when the full capacity of a stout pole line has been reached, and additional circuit accommodation is required, the loaded underground cable will prove in on the counts of capital cost and annual charges only.

It is believed that we are in sight of great improvements in the manufacture of loaded telephone cables and that it will be possible in the near future to obtain cables with conductor efficiency equal to aerial wires

weight for weight up to a limit of 200 pound gauge. The elusive phantom circuit so difficult to maintain in practice on open wires is to be a certainty in the future trunk cables. The manufacture of cables intended for trunk service requires special care and small defects which could be overlooked in an ordinary cable are sufficient to condemn a loaded trunk cable. The laying and jointing of the long trunk cable also require very expert labor and supervision. Extraordinary care must be taken in handling the cable to prevent mechanical distortion. Great precaution must be taken in the jointing and the splicing in of the loading coils. The use of rubber gloves by the jointers is imperative, and it is, of course, essential that the cable be maintained at a high insulation.

KINGDOM WIDE AND CONTINENTAL SERVICE.

We will deal first with the question of communication between two places wide apart within the boundaries of the British Isles. Reference to a scaled map of the United Kingdom will show that it is not possible for two persons to separate themselves by a distance much greater than 800 miles, measuring along roads, railways or steamer routes. The well-known motor route from Land's End to John o' Groats is only 800 miles.

Taking the generally accepted value of 46 miles of standard cable as the practical limit of commercial speech and deducting twice the maximum equalled length between a local exchange and a zone center we have 46—24=22 miles of standard cable for the main main-trunk line between zone centers. Now referring to a table of equivalents for aerial conductors we find that this standard mileage equates to a 600 pound copper loop 815 miles in length. (We have chosen 600 pound copper as it can be shown that this gauge is the most economical for long-distance lines within the boundaries of the United Kingdom.) No two zone centers in the United Kingdom are as much as 700 miles apart. The question now arises why it is difficult to ensure satisfactory connection between any one telephone subscriber and any other in the kingdom, wherever the subscribers may be located. Perhaps we may repeat the difficulties: (1) Maintenance testing facilities; (2) Urban authorities and others; (3) Overhead power systems.

We have already dealt with item (1), and we believe this difficulty will soon be solved. Item (2) presents much more serious obstacles. Our course is to educate the public and to place prominently before them the actual facts of the situation, but we look to the loaded underground cable as the most promising factor in the solution of this difficulty. We do not mean to infer that the kingdom wide service can be provided on cable circuits. We foresee, however, that as the trunk routes between zone centers become heavier, the only possible means of providing the number of circuits required for direct trunk traffic is the loaded cable: the pole lines will be relieved and in most cases need only carry the very few heavy gauge wires required for the extra long distance traffic. On the majority of trunk routes four wires will suffice for many years to come. We do not suggest that the heaviest conductors should be extended into every corner of the kingdom, nor do we think that it will ever be necessary. But there are some remote places to which the extension of trunk facilities in any case involves financial loss, taking into account only the capital cost and revenue earning power of the extension beyond the nearest trunk center. Perhaps we may give an instance. We were studying a case recently of a proposal to connect a certain small town in the far west of Ireland with the trunk system. One of our colleagues consulted us as to the gauge of conductor required. We gave him the details, and shortly afterwards he told us he had worked out the cost and he thought the cheapest scheme was to move the town to the end of the trunk line.

The proximity to overhead trunk lines (item 3) of aerial power circuits carrying alternating current causes serious noise on the telephone lines and it has not yet been possible to devise a method for ensuring continuous immunity of the trunks from the disturbance. Consequently it has been necessary to divert many long distance trunks to underground cable in the vicinity of power circuits. The possibility of communication with continental towns forms a very interesting study. Great advances in international communication have resulted during the last two or three years from the introduction of the loaded submarine cable. The present switching points for continental traffic from the United Kingdom are Paris and Brussels. The best lines from London to Paris have an equated length of 17½ miles of standard cable, and the best Brussels lines have an equivalent of 20 miles of standard cable. Taking first the case of communication via Paris, let us consider what should be the possible range of commercial speech from subscribers' stations in the center of London.

We have 46 miles of standard cable as the practical limit.

Deduct five for the line between the London subscriber and the trunk end.

Deduct 17.5 the equivalent of the London-Paris line, and we have 23.5.

Deduct 3.0 for exchange losses in London and Paris and we have 20.5 miles of standard cable available for extension on the continent. Assuming that the continental subscriber reaches his trunk end in 5 miles of standard cable, we have 15.5 for the continental trunk line. Equating this to a 600 pound circuit, we find that we have a possible range beyond Paris of nearly 600 miles radius, which brings the following cities within the reach of London subscribers: Marseilles, Lyons, Toulouse, Bordeaux, Brest, Cherbourg and practically all trunk centers in the north of France. Making a similar calculation in regard to communication via Brussels, we have 13 miles of standard cable available for extension beyond Brussels. This brings all the principal Belgian towns and some of the Dutch towns within range of London subscribers; but if we could assume that the extensions beyond Brussels were made on trunk lines of equivalent gauge to our 600 pound conductors, we should have available a radius of nearly 500 miles, which reaches several of the important German cities, including Berlin.

There is little doubt that the increasing demand for continental service will justify a better submarine cable than any hitherto laid, and we feel confident that in the near future we shall be able to obtain a circuit from London to one of the main switching centers in Belgium or Holland, having an equated length of not more than 12 miles of standard cable. This should bring Berlin and even Vienna within easy range of the London business man.

SIMULTANEOUS TELEGRAPH AND TELEPHONE WORKING.

We think that it will be useful to include in this paper a few notes on the subject of simultaneous telegraph and telephone working as affecting the efficiency and design of telephone trunk lines. The evidence for and against superposed working to be obtained from the results of experiments made from time to time on trunk lines in this country is conflicting. At the same time we have the knowledge that many of the trunk lines

operated by the American Telegraph and Telephone Company carry superposed telegraph circuits. There can be no doubt whatever that considerable economy must result from a well-organized system of simultaneous telegraph and telephone working, so it is desirable to analyze in the first place the circumstances which render superposing exceptional in this country, while on the other side of the Atlantic the practice is general.

We believe that the condition which has militated most against the success of superposing here has been the electrical instability of aerial trunk lines; the instability is due principally to the unfavorable conditions of the atmosphere and climate of this country. The American climate is, we understand, much more advantageous to the maintenance of well-balanced lines. Unfortunately the insulation and apparent electrostatic capacity to earth are the electrical factors of a line most affected by unfavorable climatic conditions; and a telephone circuit is more susceptible to want of balance in these than it is to want of balance in others of its electrical properties. It is possible to add a considerable amount of resistance to one wire of a telephone loop carrying a telegraph superposed in bridge without incurring sufficient disturbance from the superposed telegraph to cause inconvenience in the telephone circuit; but a very small capacity leak placed on one of the wires is sufficient to render the telephone working commercially impracticable.

On account of the climatic difficulties simultaneous telegraph and telephone working on aerial lines in this country cannot be regarded as sufficiently stable to justify general adoption. But climatic conditions differ enormously in different localities; where they are advantageous and the lines can be maintained in a state of electrical balance and regulation superposing may be adopted with little detriment to either service—apart, of course, from the considerations named below. Of course, it often happens that the minimum gauge of wire employable for a trunk circuit gives a margin of efficiency beyond that required by telephone transmission considerations; in such cases the economic advantages of superposing are pronounced. Apart from the question of economy of plant however, restriction is placed upon the scope of the dual working by the following considerations:—(*a*) There is an absence of automatic signalling facilities on the telephone circuit unless complicated and sensitive apparatus be used. (*b*) When a telegraph is superposed on each wire of a loop the telephone is more sensitive to disturbance from outside sources. (*c*) The operating speed of the telegraph is limited.

In addition there is, of course, the fact that the telegraphs act inductively on trunks in their neighborhood, and if the trunks are out of balance or regulation, noise on the telephones results. With the rapid extension of the junction method of operating trunks, which is now taking place the consideration (*a*) affects more and more the question of the practicability of superposed working. The difference in impedance of the telegraph apparatus (including the special apparatus required for superposing) when at rest and when working gives rise to an occasional condition of unbalance of the lines resulting in the condition named in (*b*). The restriction (*c*) results from the addition of impeding apparatus which is inserted in the circuit of the telegraph in order that the likelihood of disturbance of the telephone working on the same or neighboring circuits may be a minimum. In practice it is found essential to add this impeding apparatus.

The object of introducing the impeding apparatus is not to reduce the mean value of the current intensity but to "round-off" the curve, and so to diminish the rate of change of the current. The introduction of the impeding apparatus, of course, increases the time constant of the telegraph circuit and consequently causes a reduction in speed of operating results.

Odd Controversy in Washington

A suit filed recently in the federal court at Tacoma, Wash., whereby the government forestry department seeks to collect damages from the settlers in the Big Bottom section of this county for alleged trespass in erecting the telephone line of their local company, has resulted in further protest being sent to Washington, D. C. Twenty-four settlers living in and about Randle, Lewis county, have sent a petition to Secretary of Agriculture Houston, which sets forth the remarkable facts involved in the controversy between the forestry agents and the settlers. The question involves the right of the settlers to erect, maintain and operate a telephone line, which they themselves built along a county road, and which serves in a measure to keep them in touch with the doctor, the clergyman, the store and other agencies of civilization.

As a result of the settlers' refusal to allow the employees of the forestry department to connect with and use their line free of toll, the forestry officials have caused to be built a line of their own, at a cost of $1,500, and are demanding that the settlers' line be removed.

The petition setting forth the above facts and others pertinent to the dispute is signed under oath by telephone owners of the Big Bottom Telephone Company.

When the Tacoma Eastern was built to Morton a telephone line was built from the latter point to Randle. The settlers between Randle and Lewis wanted to have telephone connection with Randle, and as the project was not one to interest capital, the citizens attempted the work themselves. The Lewis county commissioners were seen and a hearing had on the petition of the Big Bottom Telephone Company for a franchise. The commissioners granted the franchise, which was to run for a 25-year period.

The petition just sent to the department at Washington appeals to the department as a court of last resort and asks that the difficulty be settled by some one who will treat the settlers fairly; that some one not connected with the forestry department be sent to summon witnesses and take testimony in the controversy, in order to arive at a just and equitable settlement.

"Silent Telephones" in Wisconsin

The Wisconsin Railroad Commission has decided to investigate the practice of telephone companies having what is known as a list of "silent" telephone numbers which are not printed in the telephone directories and are rung only when the party calling is on an accredited card furnished by the subscribers of such telephones.

The grounds for the investigation are that subscribers are entitled under their contract to communication with all other telephones on the system and if they are denied such service the company is not carrying out its agreement.

The Law and the Telephone

By E. J. Wenner

IS A CONTRACT A FRANCHISE?—VALIDITY OF CONTRACT—COMPETITIVE BIDDING.

THE City of Thief River Falls, Minn., is incorporated and properly organized under the laws of the state of Minnesota, and is given powers similar in most respects to the powers given cities by the laws of the various states.

The city and the Tri-State Telephone Company negotiated a certain contract which was intended to take the place of a franchise, and this contract was about to be carried into operation when A. M. Arpin brought an action to enjoin the city and the telephone company from proceeding with the contract and the building and operation of the telephone system within the corporate limits.

The proposed contract provides that the Tri-State Company shall construct and equip a telephone exchange, with 450 telephones, within the city of Thief River Falls; that the company shall operate the plant until the city purchases it; that the city, upon 30 days' notice, may purchase for $30,000, less a depreciation charge of 6 per cent per annum; that telephones installed, in the excess of 450, shall be paid for, in the evetn of a purchase by the city, at the actual cost of installation plus a 10 per cent supervision charge; that if the company operates the plant its charges shall not be in excess of certain stated rates; that the company, during its operation, shall occupy certain city property for an exchange at a stated rental; that the contract shall not be deemed to grant any franchise, right, or privilege to occupy the streets, alleys and public places, or to operate an exchange, except the right to operate the exchange until the city purchases; that the city is not bound to purchase; that the city may grant a franchise to any other company, or may itself maintain an exchange; that if the proposition to issue bonds or certificates and purchase the plant is voted down the city may offer for sale to the highest bidder a franchise to operate the plant for 20 years, and if such franchise is purchased by anyone other than the company it shall be conditioned upon taking over the exchange upon the terms reserved to the city.

The city had previously engaged in litigation relative to the statutory requirement of advertising for certain proposals and submitting contracts to competitive bidders, and it was determined that the law required that this be done. This decision effects the present controversy, for the proposed contract gave the city options to purchase the plant and the question of its right to do so without first advertising for bids is raised. Concerning this matter the court used the following language:

> The proposed contract gives the Tri-State Company authority to operate a telephone system in the city and to charge certain rates. We find no difficulty in holding the right intended to be granted by the contract to be a franchise. Whether the contract grants a franchise, or is merely a contract to construct and operate a telephone exchange, it is invalid, within the allegations of the complaint, because of a failure to comply with the provisions of the charter. The purpose of the charter is to encourage competition, to get a favorable bid for a construction for which it contracts, to get conditions favorable to itself in a franchise which is granted, or an adequate consideration for it, and to avoid the possible evils suggested in the case of Tri-State Telephone & Telegraph Company v. City of Thief River Falls, supra.

It was also contended that plaintiff had no right to maintain the action unless he could show a special injury on account of the carrying out of the proposed contract, and several cases were cited to sustain the position of the telephone company. The supreme court tok the position that if the allegations of plaintiff's petition were true the city was about to enter into a contract illegal under its charter because of the failure to advertise for proposals. This might result in more expensive construction than otherwise and possibly conditions unfavorable to the city might be incorporated into the contract and the taxpayers be given no right to object. On that theory the court held the plaintiff entitled to maintain the action, and said he might be specially injured if the contract were carried into effect.

A petition for a rehearing was filed and it was insisted that error had been committed by the court in rendering its decision. The court held upon rehearing that the question of acquiring an existing plant was not before it in the instant case, and that it was not called upon to decide whether such could be done.

The right to maintain the action was upheld and the order of the lower court was reversed.

Arpin v. City of Thief River Falls et al., 141 *Northwestern Reporter*, 833.

INJUNCTION AGAINST THE SETTING OF POLES—RIGHTS OF TELEPHONE COMPANY.

On July 21, the Independent Telephone Company of Shenandoah, Iowa, was restrained and prohibited from setting telephone poles on Thomas avenue in the municipality of Shenandoah. The hearing was conducted before Judge Wheeler in Council Bluffs and the mayor and the members of the city council were in attendance at court. While they were waiting the entire force of the telephone company were engaged in setting poles on the street in question. The telephone company had an idea that the injunction would be denied, and that they would have the advantage over the objecting citizens.

At about the time the job was completed a message was sent from the county seat that the city had won in the injunction suit, and that the poles must be removed. The same workmen immediately commenced taking up the poles and filling the holes and within the course of a few hours after the decision the street was again in its former condition.

Railroads have often put in a line of track and had it fully completed before the decision of the court was rendered, and the telephone company no doubt thought they could do the same. The court was more rapid than usual and the decision was handed down before the job was completed, thus requiring the telephone company to remove the poles.

The Telephone at Panama

Climatic conditions at Panama have led to extraordinary precautions being taken to safeguard telephone equipment on the isthmus, attention in particular having been drawn to the protective measures employed on the private branch exchange at the Hotel Washington, which is nearing completion. The switchboard is of the lampsignal type, is provided with 140 subscribers' lines that can readily be increased to 200 and has ten plug-end circuits and ten cord circuits. This board is thoroughly equipped to combat all the climatic vagaries of the isthmus; namely, that all iron work is galvanized, the interior wood work is given two coats of shellac, the cables and wiring are finished in tinned copper wire with an enameled insulation and protected by two wrappings of silk and one of cotton made in an assrtment of colors, wrapped in pairs to designate circuits. The cables are weatherproofed by a complete dipping and boiling process in an impregnating liquid solution and then renovated with three applications of shellac. The telephone instruments themselves are of the flush type made from phosphor bronze. The induction coils are first boiled in a wax compound and then two coats of shellac are applied, thus making them unyielding to moisture. All wood work in the instrument is boiled in a compound solution and then shellaced. A different system from that commonly used in this type of telephone will be tried. A jack attached to the lower wall plate is so adjusted to the connection that if a guest in the hotel desires a desk set for his own convenience, it may be arranged by inserting a plug in the jack and thus making the connection to the private exchange without altering the wiring in the least.

The transmitter and receiver are of the very latest types and are adequately protected against moisture, insomuch as the coils are boiled in a wax compound and the magnet of the receiver is given a thin coat of enamel by which it is believed that the formation of rust will be prevented from accumulating on the ends of the magnet, as in so doing it had clogged the space between the magnet and the diaphragm.

Construction in British Columbia

The provincial government of British Columbia, Canada, contemplates constructing a new 60-mile telephone line from Heriot Bay across Valdez Island to the mainland at Liughbury Inlet, where it will connect with the lines on the mainland. The chief purpose is to afford communication to fire guards and timber officials engaged in the preservation of timber. A telephone expert recently left Vancouver to survey the line. The government is also surveying a 120-mile line from Campbell River to Alert Bay, which will be of great value in keeping communication open over a large portion of Vancouver Island, although built primarily for forest protection. A similar line is now being constructed from Cranbrook up the Columbia River valley.

In connection with the 35-mile telephone cable recently laid between Point Gray, near Vancouver, on the mainland, and Nanaimo on Vancouver Island (mentioned in Daily Consular and Trade Reports for July 7, 1913) a 2-mile cable has just been laid between Mill Bay and Coal Cove, across the Saanich Inlet, which completes the cable connection between Vancouver and Victoria, via Nanaimo. This cable contains ten pairs of wires, as against two pairs in the cable between the mainland and Nanaimo, the extra capacity of the 2-mile cable being required for the constantly increasing local traffic on Vancouver Island. This cable was manufactured at Preston, England, and was made in three sections, being spliced together on its arrival here.

The number of wires in this cable, including the usual "phantom circuits," will give, it is expected, at least fifteen talking circuits between the two places. Tests have proved that phantom circuits work as well as talking circuits over the new 35-mile cable telephone, which at 1,200 feet depth in the Gulf of Georgia is subjected to a pressure of 500 pounds to the square inch.

The British Columbia Telephone Company, at Vancouver, has recently completed a school building for training new switchboard employees. The school has heretofore been held in the Vancouver central station. New employees are also given instruction in voice training under a teacher of elocution. This was found necessary on account of the varied nationalities of the girls employed. The accent of the girls from England, Ireland, Scotland, Australia and New Zealand makes it difficult to readily understand them over the telephone in some cases, particularly as the majority of the telephone patrons are Americans and Canadians.

The same company is constructing in Vancouver an eight-story $150,000 steel and reinforced concrete central station and office building.

Did She Get It?

"Halloa, there, Central. Is this Central? It is? I thought it was, but I couldn't be quite sure. The other day I supposed I was talking to Central, and it was only my grocer. I do think there are some queer mix-ups in the telephone service. What I want now is to find out the telephone number of a Mrs. John Smith—S-m-i-t-h, Smith. I find that there are more than one hundred persons of that name in the book, and I don't know which one is the husband of the lady I want. She is a large lady with a florid face and prematurely white hair, and I think her husband is a traveling man, a brother-in-law of hers, named Jones, lives somewhere on M street, a stoutish, elderly gentleman, with side whiskers. Kindly let me have Mrs. Smith's number at once. I had it on a slip of paper that I can't find. Seems to me it was two-four-sixteen ring three, or nine-two-sixty-four ring two. You know how confusing telephone numbers are. Let me have Mrs. Smith's number right away, please."—*Pittsfield Republican.*

Soldering Enameled Wire

Now that enameled wire is coming extensively into use for winding electro-magnets and for similar work, it is of interest to be able to solder the ends of such wire in a ready manner, and especially to clean off the coat of enamel so as to leave the ends bare. Where the wire is very fine, it is a very difficult matter to strip the enamel without breaking the wire, so that the present German method is a timely one. The ends of the wire are dipped for some time in boiling potash lye or in concentrated sulphuric acid, or again in a concentrated and cold lye bath, then washed for an instant with hot water and dried by dipping in alcohol. This leaves a clean surface of metal for soldering.

European Telephone Development

By Fred W. Scholz

SEMI-AUTOMATIC PRIVATE EXCHANGE WITH PARALLEL WIRING.

SOME years ago, when a bill was passed in the German Reichstag permitting the construction of smaller private telephone exchanges, the Mix & Genet Company brought out a telephone system called the Janus series wiring system. This system was semi-automatic, since it allowed every subscriber to call the exchange, while the calls from the main exchange were sent to one operator, who sent the call along by means of a line selector or some other signal system. This system became very popular in inter-office exchanges for large office buildings, and was satisfactory except for one factor. As the telephone instruments were in series, it was possible for the telephone nearest to the switchboard exchange to exclude the other telephones from calling. In business, of course, this might not be exactly objectionable, provided it is the office manager or higher officer who can exclude the lower employee, and interrupt his call in case of urgent necessity. In other cases, it is of course very objectionable to have a call interrupted by a third party. These installations are usually operated by means of microphone batteries. Primary cells are used to give the signals, which are mostly of the lamp type. The source of trouble has always been in these instruments that they are worked beyond their normal capacity, which at best is not very great. The Mix & Genet Company therefore tried to obviate this trouble, and brought out a new system of telephone instruments which used parallel wiring instead of series system. The connection of the different instruments with the main switchboard is in parallel or bridged, so that no subscriber can interrupt the conversation or break connections. To prevent two subscribers cutting in on one wire at the same time, relays are used which cut off all subscribers from the instruments in use, so that listening to the conversation is impossible. The principle of the system is illustrated in Fig. 1.

The exchange wire leads first to the switch *U*, which can be connected to the post telephone instruments *PA*. From *U* the line leads to the main switchboard exchange *EA*, and then in parallel wiring to all the other telephone instruments. All of the instruments are provided with a "Janus" switch *J*, by means of which they can be connected to the public exchange, whereby the line connecting to the line selectors *LW* is cut off. Between the Janus switch and the branch from the trunk line there is an automatically operated cut-off relay *S*, which will be described further on. As soon as one of the instruments is to be connected to the exchange wire, the cut-off device is connected into the circuit and the connection of all the other telephones with the exchange wire is established. In the diagram the telephone *N2* is connected with the exchange. The connection between the rest of the instruments and the switchboard is broken. By working the Janus switch, the wire connection leading to the line selectors *LW* is broken, so that the telephone *N2* is now dealing with the exchange only. The cut-off device *S* is electro-mechanical, and is illustrated in Fig. 2.

The device consists of the magnets *e* and *a*, the one used to connect, the other to disconnect the device and the telephone lines. The armatures of the two magnets are arranged in such a manner that the armature of *e* is cut off or affected by the armature of *a*. A switch *b* is connected to the armature *e*, and this works the visual signal *s*. The Janus switch *j* operates the contact spring *k*. The push button of this switch is arranged in such a way that, in the cut-off position illustrated in the diagram, the contact spring is lifted fromm its seat. If the button is pressed down still further, the spring comes in contact with operating contact device. To work the switching arrangement, two lines, *E* and *A*, and two battery lines are used. The corresponding connections in the different telephones are branched off in parallel. The operation for calling is as follows:

The telephone *N2*, for example, presses the Janus button and thus connects the contact spring *k* with its

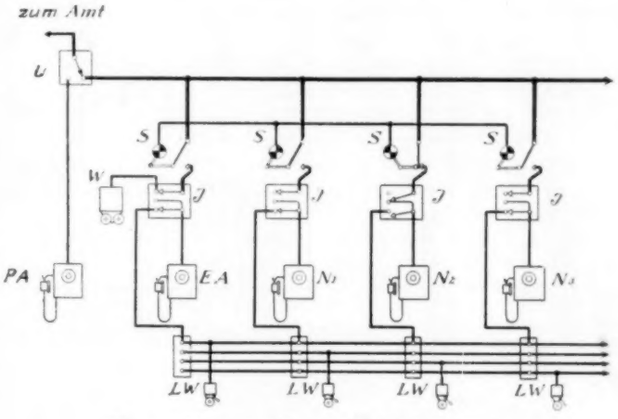


Fig. 1. Diagram of Janus Parallel Instruments.

working contact. A current will now flow from the + pole of the battery by way of spring *k*, line *E*, to all the contact springs *k* of the other instruments, from these by way of back contacts to the magnet *e* and then back to the battery. The magnets attract their armatures and the latter are held by the armatures of magnets *a*. The cut-in magnet of station *N2* is not operated, since it is cut out of the circuit by the operation of the spring *k*. During the conversation the Janus switch *j* of the station *N2* is in the position indicated in the diagram. After hanging up the receiver, the contact *c* is closed. As a result current flows from the positive pole of the battery by way of *c* and *b* of the telephone *N2*, from this to the line *A* and from here over all the switches *b* to the disconnecting magnet *a* of the other instruments. After closing this circuit, the Janus switch *J* is released, so that the contact spring *k* of the telephone *N2* returns to the original position. An advantage of this system lies in the fact that the visual flicker signals are not within the closed circuit, but are worked by means of brief current im-

pulses, when the Janus switches are thrown in or out, so that there is a minimum of current consumption and no strain on the storage batteries. All the instruments are provided with line selectors, so that there may be direct connection between various office exchanges and the public exchange. The batteries used for furnishing current for the lamp signals also furnish current for the calling over the line selectors and the feeding of all the microphone batteries. The installation costs are therefore reduced considerably, as there need be no special microphone batteries, and the voltage for the operating batteries need not be very high.—*Elek. Zeit.*

MORETTI SYSTEM OF WIRELESS TELEPHONY.

A Roman physician, Moretti, is said to have worked out a new wireless telephone system with which he claims to have established good communication over several hundred miles. The French patent governing this invention shows the principle to lie in two wiring circuits placed in parallel to a specially constructed spark gap. One of the circuits is conducted inductively to the antennae. The spark gap is limited by two electrodes produced of any sort of material. One or both of the electrodes are drilled and a liquid stream is sent through the perforation. As

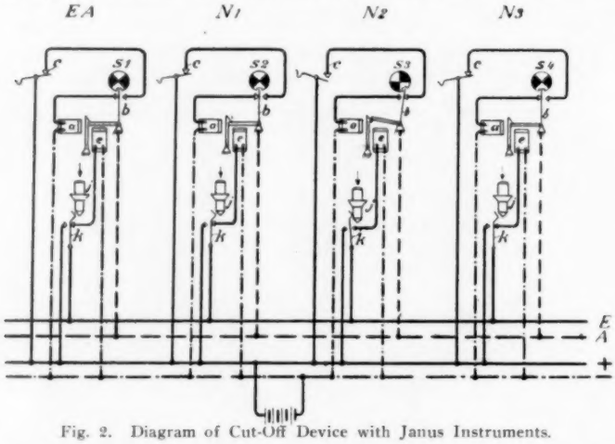


Fig. 2. Diagram of Cut-Off Device with Janus Instruments.

soon as this liquid reaches the heated portion of the spark gap, an atmosphere containing hydrogen is produced at that point. This phenomenon is supposed to produce oscillations of constant amplitude. The spark gap itself is similar to that used by Poulsen, Braun, Feukert and others. From the technical standpoint, the invention offers no advantages. If we send a liquid introduced into a discharge phenomenon produced evaporation, the discharge action is disturbed and there can be no proper oscillations under such conditions. It is very likely that the energy to be transformed to high frequency, produced by such phenomena, is limited in power. There is no comparison between the highly developed wireless sending instruments of Marconi, Lorenz, Poulsen and Telefunken, and this new invention of Moretti.—*Elek. Zeit.*

TELEPHONE MESSAGES.

The *Elektrotechnische Zeitschrift* brings a detailed discussion of a matter which, if properly carried out, would increase the usefulness and efficiency of the telephone considerably. Some time ago it was proposed to establish some sort of a message receiving and transmitting exchange in German cities, whereby subscribers could leave messages and receive calls, even though they were absent from the home or the office. Since the first proposal, the question has been agitated in German technical and public circles, and the indications are that such service may be started within a short time, if arrangements can be made to receive and transmit the messages without either involving undue expenses, or interfering with the regular telephone service. The following discussion treats the question to some extent.

The message exchange, as we may call it, would be used in these three cases:

1. Subscriber A calls up B to give him a message, but finds that he cannot reach B, and has his telephone connected to the message exchange. In this case there would be no need for any technical changes in the telephone equipment, since the operator makes only an ordinary connection.

2. A subscriber wishes to have the exchange collect all messages coming in for him, during his absence, and in that case he notifies the message exchange of his leaving, and asks that all messages be noted down. This can be accomplished in several ways:

a. His line leading to the ordinary exchange can be disconnected at the main distributing board or at some other feasible place, and the line connected to the message exchange so that all calls coming in on his wire are answered by the message operator and not by the ordinary operator.

b. At the multiple switchboard special colored plugs can be placed into this subscriber's line jack, and the operator will know that any call coming in for this wire is to be connected to the message exchange. The necessary large number of such message plugs and the frequent removal of message plugs and insertion of the ordinary line plug would of course be troublesome and might interfere with the service.

c. It has been proposed to change the connection from ordinary to message exchange by using cords having two plugs, one for the ordinary work, the other for message work. The indicator discs of the message switchboard were to terminate in the multiple jacks of the ordinary exchange. The subscriber who wants the messages recorded is connected by aid of the special cord in the multiple field with an open wire to the message switchboard and thus placed in parallel with the same. If a call comes in on such a wire the operator connects as she would under ordinary circumstances. The calls are then received simultaneously at the message exchange and at the subscriber's office. This type of connection is of course undesirable if the subscriber does not wish any of his employees to receive calls or even send them during his absence.

3. If, however, a subscriber wishes to make very frequent use of the message exchange he may subscribe to it, as is the case in Christiania. Some arrangement would then have to be made whereby the connections can be made with less trouble by the operators at both exchanges. These changes depend of course on the type of the multiple system. The matter of technical changes is secondary, after all, and if there is a need for such a message service, the financial returns would more than pay for expenses necessary through changes in equipment.

Another point which is added to the argument, and which is distinctly German, is the matter of

"urgent calls." Most German exchanges have a ruling whereby connections can be broken, and special efforts made to connect two subscribers, if the message to be transmitted is "urgent." This system is of course open to a great deal of criticism and abuse, and has led to frequent attempts to abolish it altogether. Naturally, what one man considers urgent is of no consequence to the other man, and so there has often been trouble when disconnecting subscribers to make room for the "urgent" message. There are really two types of these urgent calls: (1) Those that are urgent for the recipient of the message, and (2) those that are urgent for the sender, in that he has to leave at once, finds the other party's line busy, and still ought to transmit his message to him. The latter type is the more common, and the message exchange would solve this part of the problem by enabling the subscriber to leave the message and have it delivered as soon as the line is open.

The objection was raised that strangers might receive messages that are not intended for them and use them for their own advantage. This could be avoided by agreeing on some code word between the two parties which must be given to the operator before she will deliver the proper message. In this way it would also be possible to find out from long distances whether messages have been received during one's absence, without fear that others will obtain the information through fraudulent means.

The last point is the matter of confidence in the message exchange and the operators. It is plain that the operators in this exchange would all have to be of a type that inspires confidence. They would have to be educated, refined, beyond suspicion, and of good character. This would necessitate the payment of high salaries. There is no doubt, however, that such an exchange would be profitable and fill an urgent need. Many an important order has been lost due to the absence of the subscriber and the non-answering of the telephone. Any physician would be glad of the chance to avail himself of this privilege, since any message that would reach his office during his absence would be received and kept for him, or else communicated to him, wherever he may be at the time.

THE AUSTRIAN-DALMATIAN TELEPHONE LINE.

The Austrian Telegraph and Telephone Department recently completed the telephone line between Vienna and Dalmatia, a line which offers many interesting details in telephone construction, especially in view of the fact that good telephone communication is maintained over lines which are partly overhead and partly over submarine cables.

The territory to be covered by this line is peculiar in that it leads through a sparsely settled country, through high, rugged mountains exposed to fierce storms, which would make maintenance of the line an expensive question. The other possibility was using a submarine cable of 155 km. length. But the experiences with the English-Belgian cable, which is only 89 km. in length, did not favor such practice. In order to obtain effective communication over such a long cable and the connected overhead wires, the damping effect would have to be left very low, heavy copper conductors would have to be used, which would make the line very expensive. The length of submarine cable line was therefore reduced to a minimum, and was only used to connect the few islands between the coasts of Istria and Dalmatia. The total of these cables is not more than 58 km., divided into four lengths. The cost for the cable could be reduced, to be sure, but the change from cable to overhead line was a matter of doubt in regard to effective communication.

When we have telephone communication for long distances, the modern telephone engineer thinks immediately of the Pupin coil, whose characteristics are arranged in such a way that there are no losses in the communication of sound from one line to another. Theoretically, the Pupin coil promises great effectiveness with little loss of current. In spite of recent successes with these lines, it seems that there are still some objections to their general introduction, especially for overhead wires of heavy wire.

It is well known that the magnitude of line leakage is the decisive question as to the effect of Pupin coils on such lines. This leakage is a very variable quantity with overhead lines, and dependent on climatic conditions, etc. An insulation of 10 megohms per km. as used in this country seems too high for European conditions. The measurements of Devaux-Charbonnel show that the insulation on French lines sinks at times to 0.5 meghoms per km., the wires being 5 mm. wires. Fleming places the insulation resistance on English lines at 1.5 meghoms, and the Austrian figures lie between 1 and 2 meghoms per km. There is therefore grave doubt as to the advisability of increasing this coefficient to the American figure.

In the Austrian lines the leakage is very great, due partly to the salt deposits on the wires. The salt from the sea is carried inland by the storms and forms in white crystals on the wires, insulators and poles. When the warm weather begins, these deposits are of course melted and swept away, but meanwhile they form an excellent conductor between wires and earth. It seemed, therefore, advisable to use 5 mm. bronze wires for overhead lines. Within Vienna city limits the new line was connected to the cables of the exchanges, whose conductors are 2 mm. copper wires, surrounded by a fine layer of iron wire. Krarup cables were used for submarine cables. After leaving the Vienna cables, the lines are conducted by 5 mm. bronze wires over wooden poles. Porcelain insulators of the ordinary petticoat type are used throughout. The two wires of the double lines are crossed every 1,000 feet. On the smaller islands used by the line, telephone and telegraph wires are on the same poles. There is no interference by telegraph clicks, as the telegraph offices use small condensers and choke coils to avoid such trouble. The 5 mm. wire was used throughout, except in passing through villages, where 4 mm. wire was used. The electrical characteristics of the wires are as follows:

	Overhead Line	Krarup Cable
Direct current resistance in ohms	1.77	11.10
Effective resistance in ohms	1.814	11.40
Capacity C in 10^{-6} Farad	0.00554	0.03880
Self inductance in 10^{-3} henry	2.08	6.40
Leakage in 10^{-6} megohms	0.405	2.500
Specific damping effect	0.00161	0.01420
Wave length, constant (alpha)	0.01704	0.1594
Wave length in km	368	39.5
Transmission speed in km.-sec	294.000	31.400

The characteristic for the overhead lines connecting to the cables was taken at about 618, which would have been between 800 and 1,000 if Pupin coils had been used. Pupin coils in submarine cables give excellent results from the electrical side, but not so good

from the mechanical side. The strength of the cables is lowered by the use of the Pupin coils, and the places where the coils are built in are not as resistant to mechanical influences as might be desired. This had to be taken into account in this line, as the sea through which the cable runs is very rough and exposed to violent storms. The repair costs would have been higher than is the case with Krarup cable, and so the electrical efficiency was sacrificed for mechanical reasons. Gutta-percha has been used exclusively for insulation. The German cable works could only use the ordinary gutta-percha, not having the right to use the special gutta-percha used in the English-Belgian cable. The cable has two circuits, that is, four pairs of conductors. There is a center round copper wire of 2 mm. diameter, surrounded by three flat wires of 2.5x0.38 mm. cross section. The copper conductor is covered with three layers of soft iron wire and then surrounded by gutta-percha to a thickness of 8.3 mm. The average weight per km. cable length is 51 kg. for copper, 32.4 kg. for iron, 44.5 kg. for gutta-percha. The four conductors are twisted separately in two strands. Two conductors are twisted right, and two left handed. The cable becomes somewhat heavier and requires more space, but there is no danger of sound passing from one conductor pair to the other. To protect the cable against worms, a thin layer of brass is spun around the conductors beneath the iron wire. Near the coast the cable is further reinforced with 20 galvanized iron wires, each 7.1 mm. diameter. The weight of the completed cable per km. is about 8,900 kg. The cables were laid in a period of nine days, interrupted by storms. The only question that caused a little anxiety was the inductance in the cable due to the thin iron wire surrounding the conductors, and the relation in which this increase of inductance stands to the increase of effective resistance. This fear proved groundless, however, as also the fear that the increased self-inductance would be accompanied by excessive eddy-current losses. So far this line has worked to great satisfaction and has given no cause for trouble.—*Elek. u. Masch.*

Missouri to Form New Association

At a meeting held in Sedalia, Mo., on July 15, 1913, composed of a number of telephone managers, it was agreed by those present that a state telephone association was an imperative need. In view of the changed conditions in the telephone business of Missouri, owing to the control over the industry given to the Public Utilities Commission, and the further control vested in the Interstate Commerce Commission, it seems necessary that the telephone owners of the state should organize themselves into a compact working body. The purpose of this organization would not be to oppose the workings of either the Public Utilities Commission or the Interstate Commerce Commission, but rather to aid in enforcing the rulings of these commissions by co-operating in carrying out the provisions of the law, and in enabling the commission to establish fair, reasonable and adequate rates and fair and just rules and regulations. Many questions are being asked the Public Utilities Commission that should be answered by a conference of telephone interests. Points of difference between telephone companies are being brought before the commission for adjustment that ought to be "ironed out" by the telephone companies themselves. No doubt a strict conformance to the rulings of the commission will result in placing the telephone business on a much stronger footing, provided those rulings are made after careful study by the commission of the conditions existing. But only by an organization can these conditions be adequately and accurately presented.

The handicap of the commission, the telephone companies, and the public today, is lack of information. An organization can compile the information and properly explain it to all three parties. Already the orders doing away with free service, discrimination in rates and difference in toll charges have done much towards causing the public to realize that the telephone companies have been at a disadvantage.

In order to comply with the book-keeping regulations of the Interstate Commerce Commission and the probable adoption of the same regulations by the State Commission, it is imperative that the telephone companies take some action to aid the small companies to comply with the regulations at the least expense.

The old independent organization has seemingly dropped into a state of lethargy and is doing nothing toward helping conditions that now exist and will from time to time come up for an adjustment.

For these and other reasons it was thought best to call a convention immediately, to form the proper organization to harmonize all telephone interests within the state. The call is sent out to all telephone companies, regardless of toll line connections (whether independent or Bell). Toll line companies and companies controlled by toll line companies are not included in the call, as it was thought best to let the question of admission of such companies be left to the convention for its decision.

The date set for the convention is August 20 and 21, 1913, at Terry Hotel, Sedalia, Mo. It will be a meeting on strictly business principles, without any set program. The Utilities Commission of the state will be asked to have one of its members present and to give its position on telephone matters in general. The meeting will probably continue over to the day following.

Everyone in the telephone business in Missouri should make an especial effort to be present and aid in working out the many problems of the business in that state. Among those responsible for the association are:

J. L. Plummer, Ava, Mo.; Joseph Minter, Otterville, Mo.; C. W. Boutin, Cape Girardeau, Mo.; G. W. Schweer, Windsor, Mo.; W. N. Wick, Willow Springs, Mo.; C. Wolsers, Hopkins, Mo.; T. J. Buchanan, California, Mo.; R. A. Guthrie, Macon, Mo.; W. J. Gold, Clarksburg, Mo.; B. E. Eoff, Warsaw, Mo.; W. E. Owens, Clinton, Mo.; H. McHenry, Jefferson City, Mo.; Waldo Edwards, Bevier, Mo.; H. C. Todd, Maryville, Mo.; J. S. Arni, Otterville, Mo.; Henry Borling, Cole Camp, Mo.; A. E. Wright, Cole Camp, Mo.; L. L. Richardson, Calhoun, Mo.; F. H. Thompson, Cameron, Mo.; J. B. Gooding, LaPlata, Mo.; Ed. A. Hook, Appleton City, Mo.; Ed. A. Hook, secretary, Appleton City, Mo.; Houck McHenry, president, Jefferson City, Mo.

Anyone unable to attend the meeting should write Ed. A. Hook, secretary, at Appleton City, expressing his ideas concerning the nature of the organization to be formed.

Liability for Public Telephone Location

A question as to the liability of a telephone company for injuries to a person who entered a store to use a public telephone has been decided by the appellate division court in favor of the telephone company, although the court could find no similar case for precedent.

Mary E. Sullivan sued the New York Telephone Company and Barr & Company, shoe dealers at 3 East Forty-second street, New York, and got a judgment against both. The testimony showed that on December 29, 1910, Mrs. Sullivan saw the telephone sign and entered the store, where she was directed to the telephone. After using it she stepped through a trap door and received permanent injuries.

The jury decided that both the telephone company and the shoe concern were negligent. Counsel for the telephone company pleaded that the telephone company had no control over the premises where the accident occurred, but the trial justice ruled that the company must see that its telephones were not installed in dangerous places.

Justice Laughlin, writing the appellate division decision, said that there was no basis for recovery against the telephone company as it was not in possession of the premises.

The court says the trial judge should have dismissed the complaint against the telephone company.

Tri-City Automatic to Build

Material for the construction of the new automatic telephone system to be installed in Moline, Ill., is now on its way, according to the statement of L. W. Stanton, promoter of the Tri-City Automatic Home Telephone Company. Mr. Stanton states that the work will be started at once. The question of franchises in the three cities has been satisfactorily settled, and it is the intention of the company to offer service to its patrons within the next year.

The company contemplates the laying of forty miles of cable in Moline, the entire system in the downtown section and in a large portion of the close-in territory to be laid under ground. The trunk lines to Rock Island and East Moline will also be underground.

Engineers have completed the preliminary work in connection with the construction details, and as soon as a sufficient quantity of material arrives a large force of men will be placed on work on the installation. At least this is the promise of promoters of the new company.

Inter-State Company's Chicago Connection

The Inter-State Telephone and Telegraph Company, with general offices in Aurora, Ill., may have Chicago connection with its closest rival, the Chicago Telephone Company. It was announced by General Manager L. C. Griffetts of the Inter-State Company that should the Illinois Telephone and Telegraph Company sell out to the Bell interests legal action will be started to compel the latter to connect up the lines of the Chicago company with those of the Inter-State at the Chicago city limits.

The public announcement that the Illinois company was seeking permission to sell out aroused officials of the Inter-State company to action. Users of the Inter-State telephones have Chicago connection over the Illinois company lines, which connect with the Inter-State lines at the Chicago limits. The sale of the company to the Chicago Telephone Company will mean that the Inter-State will be without Chicago connection unless over the lines of the Chicago Telephone Company.

Telephones on Mount Baker

Through the co-operation of the forestry department with the Mount Baker Club, which is in charge of the annual Mount Baker Marathon, telephone wires now encircle Mount Baker, stretching along three trails and connecting the three sides of the mountain. A wire will be laid on the snow from the snow line on the north side on what is known as the Glacier trail clear to the top of the mountain. This is to keep in touch with the runners who will race to the summit and return August 15 in the annual Marathon. The runners will go by two trails, the west and the north, and telephone wires will be strung to the summit on both trails. Temporary stations will be established the day of the race to keep close account of the runners.

Teakwood Poles in Siam

Teakwood telegraph poles, placed closer together than in this country, would make interruptions of telegraph and telephone communication much less frequent, according to C. Zisswiller, chief electrical engineer of the Siamese government, official head of the government-owned telegraph and telephone system of that country.

"All the telegraph poles in Siam are of teakwood," says Herr Zisswiller. "It is much stronger than the wood used here. The cheap construction of your telegraph lines, I suppose, is necessary because of the vast amount of material required to traverse the great distances. In Europe, as in Siam, poles are set closer together."

Band Concert by Telephone

The United Telephone Company of Temple, Tex., has placed a transmitter in the grand stand of the city park whereby every subscriber can be put in connection with the summer concerts at the city park. All that is necessary is to take down the receiver, ask to be connected with the band concert, and one hears the strains of the music at the park just as clearly through the telephone as if he were present at the park. This was installed for the benefit of those who through illness or other causes are unable to attend the concerts.

Revelations incident to the congressional lobby inquisition have inspired Senator Cummins to undertake to safeguard public officials from the perils of "impersonation." He makes such use of the telephone a penal offense. Substantial fine and imprisonment are prescribed.

An American consul in Spain believes that there is an opening in the cities of his district for automatic telephones, and he would be glad to hear from companies manufacturing them.—File No. 11160, Bureau of Manufactures, Washington.

Oklahoma Connection Case

Alleging that a number of the largest and most important telephone and telegraph companies in Oklahoma, including the Pioneer, are owned and controlled by the American Telephone and Telegraph Company, the Oklahoma Corporation Commission mailed to the Interstate Commerce Commission a complaint and a request for an order compelling the companies believed to be under the control of the American Telephone Company to establish rates and connections with the Arnett Telephone Company of Oklahoma.

The companies named in the complaint and alleged to be under the control and ownership of the American Telephone Company are the Pioneer Telephone and Telegraph Company; the Southwestern Telephone and Telegraph Company of Texas; the Home Enterprise Telephone Company of Oklahoma and the American Telephone Company.

Prior to July 12, 1912, the companies in the complaint, it is stated, made connections with the Arnett company for points served by the different companies in Kansas, Oklahoma and Texas, but subsequent to that date they have failed and refused to allow the Arnett company to make connections with them. The refusal, it is alleged by the corporation commission, was brought about by the American Telephone and Telegraph Company.

So far as known by the commission this is the first case of its kind on record where a corporation commission has sought to force one telephone company to establish through rates and connections with another company.

Connection Decision in Omaha

In an order made dismissing a complaint filed against the Pacific States Telephone & Telegraph Company by C. P. Bowman, the Oregon Railroad Commission held that under the law it has authority to direct physical connection between telephone companies. The decision is considered important, as this is the main question raised by the Pacific States Telephone Company in resisting the complaint before the commission by the Oregon Hotel Company of Salem in which the latter asks that the telephone company be made to give an exchange service in the hotel with the Home Telephone Company. Bowman and others own a small telephone line in eastern Oregon and desired to have the Pacific Telephone Company exchange service with it, but the commission dismissed the complaint on the ground that the particular connection requested was not public necessity.

Nebraska Commission News

Authority to issue $1,100,000 of additional 5 per cent preferred stock has been given the Lincoln Telephone and Telegraph Company by the Nebraska Railway Commission. The company filed an application some time ago to have this stock sanctioned. It has outstanding at the present time something over $2,800,000 of stock, and the additional amount will bring the total up to nearly $4,000,000.

The order of the commission allows the company to sell the shares at 92 cents on the dollar.

Approximately one-half of the new stock will go to the Bell telephone interests, as President Woods testified at the hearing that his company has borrowed $550,000 from that source with the expectation of repaying the loan in stock. The remainder will be used to meet the cost of various improvements and extensions, including new buildings in Lincoln, Beatrice and elsewhere.

In a separate order, the railway commission has authorized the Lincoln company to complete the purchase of the following properties at the amounts specified:

Hastings Independent Telephone Company, $134,085.

Fillmore County Telephone Company, $41,522.

DeWitt Telephone Company, $22,525.

Total for all three, $198,132.

South Dakota Commission News

P. W. Dougherty, attorney for the South Dakota Railway Commission, in the department of the attorney-general, has held that special rates to stockholders of telephone companies, under any guise whatever is illegal and must be stopped. In the case of the Gas Belt Company of Okoboji, a rule was adopted to sell telephone instruments to stockholders at cost, the money to be refunded if the instrument should be returned in good shape if the stockholder dropped out, with the further provision that non-stockholders be required to put in their connecting lines to the main lines, under regulations of the company, which is held to be discrimination. In the case of the Ellendale Savo Company free service to stockholders on local connecting exchanges with a charge to non-stockholders is declared to be discriminatory; and in the case of the Brookings-White toll line, evidently owned by the local exchanges of the two towns, attempt to give free toll to their subscribers in either town, with a toll charge to non-subscribers, which is also ruled as not legal.

The railway department is preparing a uniform system of accounting for local telephones not doing inter-state business, and will demand reports under their system as soon as the plan is completed.

Tennessee Commission News

In the case of the Houston County Telephone and Telegraph Company against the Cumberland Telephone Company, in which the former charged the larger company with trying to run it out of business by cutting rates and giving free service over Houston county, the Tennessee Railroad Commission decided in favor of the smaller company, handing down the following order:

> In this cause, upon complaint of Houston County Telephone & Telegraph Company, the Cumberland Telephone & Telegraph Company is hereby ordered to desist and cease charging rates for telephone exchange service in Houston county less than the rates charged by the Houston County Telephone & Telegraph Company and neither company shall hereafter allow any free exchange service to their respective patrons.
>
> This order effective August 1, 1913.

Twenty years ago there were about 9,000 telephone stations in New York, served by seventy central offices in Manhattan and one in the Bronx, and the rate charged subscribers was $240 per annum. At present there are in Manhattan and the Bronx alone more than 350,000 stations.

DEPARTMENT of RAILWAY TELEPHONES

Wire Chiefs and Telephone Inspectors

By J. B. Sheldon*

UNTIL quite recently, in a comparative sense, the matter of organization for wire chiefs and telephone inspectors has not generally had very close or considerate attention, conditions being usually accepted and followed as found, partly because business conditions in general were not formerly figured down to so fine a point, to some extent owing to the demands on the service not being so great as to urgently require improvement and in a way because help and facilities at our disposal were not such as to permit of elaborate systematization. But, with what might be called an awakening or efficiency movement, we have keenly felt the necessity of progress in this and other matters, as have others in their particular fields of effort.

First of all in importance, I would say, is the upkeep of the lines of poles and wires and equipment; for, with the plant in perfect order, our troubles are greatly minimized.

The general practice heretofore extant of allowing pole lines to stand intact up to the very last of their possible life, in many cases far beyond reasonable safety, with the hope that visits of violent and unusual storms may not occur, has been a very serious and seemingly insurmountable drawback, as it has left at the easy mercy of the elements, at all times, more or less of the machinery of our establishments. With the new plan evolved by the Western Union Company, of pole to pole inspections and repairs and replacements here and there as found needed, more as a railroad track is maintained, we welcome the hope that before long our lines may be so uniformly well maintained that extensive troubles will be of extremely rare occurrence.

It is important, too, that wires should not be allowed to remain in service without replacement, especially in the worst spots, when they have become so badly rusted or otherwise defective as to cause excessive trouble, not only in such wires themselves, but, in other wires as well, by becoming mixed therewith when breaks occur in them.

In addition, in order to secure desired results, the ordinary maintenance of the lines and wires by section linemen must be kept up to a high standard.

Then, the inside plant, consisting of telegraph and telephone equipment, especially since it is constantly becoming more complicated and important, needs keeping up in the best workable condition and modernizing now and then as improved methods of operation become available.

It may be needless to say that thorough and frequent inspection is necessary—more than a superintendent, with his usually more or less onerous office work and other duties to look after, can conscientiously attend to; and hence the necessity on the larger roads for a general outside plant inspector and a general inside plant inspector to properly supervise and care for the property, while on some of the smaller roads the duties of the two positions may be merged under one general plant inspector.

The general outside plant inspector should be a practical telegraph construction man, fitted to lay out and oversee construction and reconstruction work under foremen with gangs, in accordance with specifications applicable thereto, as well as check up the work of section linemen and see to the proper ordinary maintenance of the lines by them.

It is necessary that the general inside plant inspector should, in addition to a thorough knowledge of modern telegraph equipment, be a telephone expert, capable of installing and maintaining telephone train dispatching and other apparatus in a highly efficient manner, besides directing and overseeing the work of division telephone inspectors as well as section linemen in respect to equipment.

Where a single general inspector is employed to look after both the outside and inside plant, he should, in respect to qualifications, be a composite of the outside and inside inspectors.

Next in importance to

*Paper read before the Association of Railway Telegraph Superintendents.

Department of Railway Telephones

This department is established as a permanent feature of TELEPHONE ENGINEER. The progress of the art of telephone train dispatching, its technical development, its news, and the elucidation of its mysteries for the non-technical worker will be found each month in these pages. The editors invite the problems and solicit the co-operation of the many readers of TELEPHONE ENGINEER in all parts of the world whose interests lie along these lines.

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the keeping of the plant as free from troubles as conditions will permit, comes the accurate and prompt location and expeditious removal of troubles that do occur, that the wires may be available for the service required of them to the best possible advantage; and, for this particular service, skillful and energetic wire chiefs are required.

Wire chiefs should be located preferably at principal division points, where many, if not all, of the wires, for the working condition of which they are responsible, terminate and receive current for operation.

The managers of terminal offices, in many cases, act as wire chiefs during their hours of service, with others, called wire chiefs, in charge of the wires at other times; although more modern and perhaps preferable practice seems to assign the responsibility for the wires to wire chiefs throughout the day and night, leaving the managers free to look out for the general operation of the offices, which are usually important ones, without the burden and frequent interruption incident to the care of the wires in detail.

A difficulty frequently experienced, lies in the appointment of managers and wire chiefs at principal terminal points, on account of such appointments being made largely on the seniority plan rather than with regard first to the unquestioned ability of the individuals properly and satisfactorily to fill the places at the start. Fitness is undeniably the prime element to be considered, and thus, to secure the best results, the superintendent of telegraph should have quite a free hand in the selection of such help, endeavoring, however, to favor the older men in the service to the greatest extent conditions will permit.

Comparatively few telegraphers seem to interest themselves in the duties of wire chiefs or endeavor to qualify themselves for such positions in advance of an opportunity to secure such a place. This may be to some extent on account of seemingly slow advancement, which causes them to put off the study, or they may be discouraged or not assisted by the manager or wire chiefs in their efforts to post up on the work. However it may be, the older men are very frequently not qualified for these better places, so as to fill them successfully, when vacancies become available for them.

The offices at which wire chiefs are located, should, without question, be under the immediate jurisdiction of the superintendent of telegraph, instead of under the control of division railroad officials, as only by this plan can the through wires, as well as the local division circuits, depend upon receiving the attention they require.

While it is a fact that wire chiefs frequently become very proficient in locating trouble by old fashioned methods, modern practice recognizes that something more than a telegraph set is required to make positive tests and secure the accuracy and speed that are essential in this work.

Each division office, where wire chiefs are employed, should be furnished a voltmeter and milliammeter, and, in some cases, a wheatstone bridge, although the latter is not always a necessity.

The voltmeter is very essential for testing offices of any importance, as it is next to impossible to become and keep thoroughly familiar with wire conditions from day to day without this instrument. It can be used in testing for grounds, crosses, opens, reverse battery and in making insulation tests, and, in most cases, will give very accurate results.

The milliammeter is also quite important, in fact, just as essential as the voltmeter. With it can be determined whether or not the proper amount of current is being furnished to operate the relays on the various circuits. This is an important feature that is worthy of proper attention. This instrument can also be used to advantage in locating short circuits on telephone train dispatching circuits, or on any other telephone circuits that are bridged by a number of instruments without condensers in series. Of course, it is necessary, or at least desirable, to make tests between the various test offices when the line is normal, to determine the flow of current in the circuit with each section cut off. Record should be made of these readings for comparison in case of trouble.

A test panel, with voltmeter and milliammeter should also be provided at the dispatcher's end of all telephone train dispatching circuits, even if such places are not important or regular test stations for other circuits. The importance of locating trouble on these circuits quickly and accurately, as can be done with these instruments, far overbalances the expense involved in the purchase of the equipment.

With these instruments, wire chiefs should make monthly tests, of all wires of which they have charge, to determine the insulation resistance, which should approximate 100 megohms per mile, and the strength of current, which, with 150 ohm relays in use, should be maintained at not less than 40 milliamperes for satisfactory results; and, where noticeable variations from these standards are evident, report thereof to the superintendent of telegraph should be made for regulation.

The importance of trouble being correctly reported to section linemen or division telephone inspectors by wire chiefs, both as to location and nature, cannot be overestimated. While speed is very desirable in this matter, reasonable time spent to insure correctness is bound to be fruitful of good results in the end, as the better facility thus afforded the repairer usually repays many times for the effort.

In the testing and patching of wires, it is essential that wire chiefs should have prompt, intelligent and considerate co-operation of employees at wire testing stations. To further this result, it is desirable that all new employees should be required to pass an examination upon this work; and that, when they are placed in service at wire testing points, they should specially post up in respect to these duties, and be impressed with the importance of them. It is also desirable to place framed copies of wire testing and patching diagrams in such offices, in proximity to the switchboard, where they will be handy for ready study and consultation. If wire chiefs should find employees at testing stations not qualified for the work at any time, report thereof should be promptly made to the superintendent of telegraph for improvement of service.

There is sometimes a tendency on the part of wire chiefs to become unduly impatient and exacting in their dealings with employes at wire testing stations, which does not produce harmony or reflect to the good of the service. They should appreciate that the good will of those with whom they come in contact is of inestimable value.

It goes without saying that wire chiefs should keep a comprehensive "log" of wire conditions day by day, showing the time of occurrence of trouble, in what wires, the approximate location and nature of it, as first determined, as well as the exact location and cause, as afterwards found.

It is desirable that information, as above, should be promptly furnished the superintendent of telegraph, by wire, as trouble occurs and as it is cleared, in order that he may be kept fully informed as to wire conditions; and it is considered of value to the superintendent of telegraph that he should keep a record, similar to the wire chief's "log," of all troubles from day to day as they occur, so any unusual delays in clearing, or undesirable conditions existing, may be readily noticed and action taken to overcome.

Wire chiefs should check the new *2,777* reports of section linemen, not only to make sure of receiving a report in each case, but to see, as well, that they are correctly prepared in every way.

It is desirable that the time of occurrence of troubles should be given in the notifications to section linemen, so they may have this information to enter in their *2,777* reports and also know just what delay has occurred before the receipt of notices by them.

Wire chiefs should give the section linemen as much information about the nature and location of troubles as they may be possessed of, so as to assist them as much as it may be in their power to do in locating and clearing the defects.

Sometimes wire chiefs are careless about notifying section linemen, when wires come clear without trouble having been found and removed by the linemen. In this way valuable time of section linemen is wasted when it might be better employed; and such disinterest on the part of wire chiefs is discouraging to the linemen and resented by them.

Wire chiefs should promptly give O. K. to reports from section linemen of removal of trouble, or advise them, without unnecessary delay, that trouble still exists, if the supposed clearing of the trouble fails to change the conditions.

It should be the duty of wire chiefs to keep posted as to the whereabouts of section linemen under their direction, so they may be reached promptly when they are needed on trouble calls.

It is also desirable that wire chiefs should know the location of all telegraph gangs that may be employed in their territory, in order that assistance may be had promptly from them when conditions require.

Railroad sectionmen can also occasionally be of much help, especially in outlying sections that section linemen cannot reach without much loss of time, in the making of temporary wire repairs, bracing up or resetting poles, etc., and wire chiefs should arrange for their assistance where it is urgently needed.

Wire chiefs should keep posted on the weather and other conditions on their districts, having bearing on the working of the wires, and promptly inform the superintendent of telegraph of any unusual conditions that he should know about.

Division wire chiefs cannot always conveniently reach local district circuits for tests when trouble occurs in such wires, and it should be arranged, in such cases, for the tests to be made by the principal offices having access thereto.

All offices on single wire lines, where there is no other wire to test with, should make tests of their own volition, as far as they are able to do, with view of securing workable use of the wire from both ends as close up to the trouble as can be done.

Then, the section lineman is an important personage and his activities and skill have very much to do with the satisfactory operation of the wires.

The selection of section linemen should be made with care, to insure the conscientious and competent work that is required. Men suitable for important sections are frequently very difficult to find, and it seems necessary for the ultimate good of the service, that men who apparently possess the necessary qualifications, should be picked out from gangs and encouraged to fit themselves fully for these places so as to be available when needed.

It is a fact that the work of these men is constantly becoming more difficult and complicated, owing to the increase in number of wires, longer cross-arms to work on, telephone transpositions to observe, etc., as well as the addition of many telephones and other apparatus; and, at the same time, better results are expected of them in every way.

The conditions above mentioned, must ultimately result in the putting on of additional men in order to reduce territory. This matter should have consideration in time, that the lines and equipment may not become serously run down through inability of present help to properly maintain.

Section linemen should be expected to keep their lines in a high order of repair, and should ordinarily cover all of their territory, for inspection and such repair work as is required, at least once a month. In inspections, everything connected with the plant should have attention, including the general condition of the poles, anchors, cross-arms, pins, insulators, wires, tie wires, instruments, switchboards, fuses, arresters, batteries and other equipment. If there are any defects found that he is unable to fix, or if help is required on some of the work, the matter should be promptly taken up with the superintendent of telegraph for attention.

The section lineman should always keep his headquarters office informed as to his whereabouts, so he can be readily reached when needed. For this purpose, it is desirable to locate a hook in the office, upon which he should place a location memorandum when he leaves, and upon which messages from him from along the road, advising as to his movements, may be kept.

When trouble is reported, employees of the office at the section lineman's headquarters should get word to him at the earliest possible time; and the lineman should start out on first available train or by motor car. Much valuable time can be lost by carelessness or indifference in these matters.

Another very important consideration, that should not be overlooked, is the prompt reporting of clearance of trouble to wire chiefs by section linemen. They should make such reports at the earliest possible time and offices handling them should expedite the service thereon, in order that wires, which have been in trouble, may be placed back in use with the least possible delay when they are made clear.

Where telephone circuits are available, it is desirable to supply section linemen with telephone test sets, so they may notify wire chiefs of the clearing of trouble immediately, instead of waiting, as is otherwise necessary, until they reach a telegraph office.

The new plan of the Western Union Company, hereinbefore mentioned, of reporting of trouble more in detail by section linemen by mail on form *2,777*, in addition to their telegraphic or telephonic reports at time of clearing, produces very desirable results; as the comparisons made therefrom in blue print form, which are furnished all concerned, show up the weak spots, not only in the lines but in the repair service as well, and enable us to apply remedies where most needed. These compar-

isons also cause keen rivalry to exist between section linemen, between different railroads and between different districts and divisions of the telegraph company, which keeps all concerned keyed up to their best efforts and accomplishes great good to the service.

Care should be taken by section linemen to make up these reports correctly, and they should endeavor to see that all cases are reported, whether the trouble is cleared by them or by sectionmen or others, that the records may reflect true conditions. Foremen in charge of gangs should be supplied with forms 2,777 and instructions, so they may make reports of trouble cleared by them or their men.

Section linemen should call on railroad sectionmen to help raise poles, and in other work where assistance is actually required in emergencies for short periods of time. Sectionmen can also frequently be of great assistance in making temporary repairs before section linemen can reach trouble. It is desirable that sectionmen should have general instructions to help out in these ways.

While division telephone inspectors, where such help is employed, are supposed to take practically all of the care of telephone equipment, section linemen should post up on this work and help out therein to the best of their ability when occasion demands.

Section linemen should not rest content when trouble comes clear without their finding and remedying the cause, but should bear it in mind and continue to look for it, as the chances are very much in favor of the trouble occurring again if not located and corrected.

Motor cars are quite a necessity for section linemen, to facilitate ordinary repair work as well as to expedite removal of trouble, especially where train service is not frequent or convenient enough during the day to fully answer their needs; and it is considered that the better results to be had through the furnishing of this facility pays for the expense involved many times over.

While there is considerable difference of opinion as to the necessity for division telephone inspectors, some maintaining that the care of telephone train dispatching apparatus can be properly looked after by section linemen, it is the writer's belief that, under ordinary conditions, separate help, more skilled in this particular work and constantly available for this service, is essential for thoroughly satisfactory results.

It may be true that, with section linemen located comparatively close to each other, so as to shorten up on the average ordinary section, with the lines in first-class condition, so as to minimize troubles and work upon the lines, and with a moderate amount of battery to look after and other work to do, section linemen, after posting up on the equipment, could take care of the telephone work very well, in addition to their other duties; but, conditions do not always favor us to this extent, we could not depend on their remaining so indefinitely, and, the expense involved, in the end, might at least equal the outlay under the plan of having separate inspectors, without securing the benefits to be had from the employment of a comparatively few extra men specially skilled in this work.

Where special telephone inspectors are employed, they can cover quite an extensive territory, frequently a railroad division, and, if the territory assigned is too great to enable them to attend to all the details, the section linemen can assist as may be necessary.

With the employment of such special help, we can be quite sure of having some one available to promptly look after equipment troubles, whereas, with only section linemen for this work, the service might frequently be tied up for quite long periods while they would be engaged in repair of line troubles; and the service seems to be of sufficient importance to warrant surrounding it with every reasonable means to insure its operation with the least possible interruption.

An inspector is usually easier to reach than a section lineman, as his work is practically confined to offices, so he may be found either at some office or traveling on some train, while the work of section linemen is generally out on the line, away from ready communication, so they frequently cannot be reached for quite long periods of time. An inspector can thus, in many cases, be located and fix up defects, that have caused suspension of service, before notice thereof could be brought to the attention of a section lineman.

It is also desirable to have an expert in this line of work within reasonable distance, to safeguard the service from excessively long interruptions, on account of troubles of a more or less baffling nature that a section lineman, with limited experience and knowledge of conditions, would not be able to readily locate and clear.

The qualifications of a telephone inspector include a thorough knowledge of the equipment, a disposition and the ability to do good substantial work, a desire to have everything in ship shape order and a willingness to keep on the go energetically, as conditions require, for the maintenance of the service to the best advantage.

Telephone inspectors should always carry with them such tools as they are likely to require in any ordinary work, such repair parts as they may most any time need and a set of batteries. All of these things can be easily carried in a kit, and, as they have no lugging to do for long distances, a fair-sized kit is no burden.

Systematic and thorough inspections over their entire territory should be made at least once a month, and it is desirable that this should be done by means of motor car, preferably a car having four wheels, to enable them to stop at all booths and sufficiently long at stations to make their work complete. They should then make such repairs as they are prepared to do and afterwards follow up with such other work as is required.

These men should not be disturbed while on regular inspection trips any more than is actually required, so the work may not be unnecessarily hampered or delayed; section linemen to be used for minor telephone work at such times as far as can satisfactorily be done.

They should endeavor to replace batteries before they entirely fail, although making use of them, in the interest of economy, as long as they can be expected to give reliable service. Record should be kept of battery replacements, to enable them to know whether they are properly used and about when it will be necessary to again renew. Record should also be kept of renewal of all other equipment.

Where registers are in use for the taking of train orders by trainmen, inspectors should see that they are supplied with train order forms and carbons and kept in usable condition.

Reports of inspections should be made to the superintendent of telegraph, showing renewals of battery and equipment at the different stations and booths and giving reference to any conditions for the good of the service that it is considered he should know about.

And, finally, inspectors should help out in emergencies, as their regular duties will permit, in the maintenance of the telegraph and telephone plant in general.

Power for Selector Circuits

By Richard F. Spamer*

THERE were in service at the beginning of 1913, in round figures, 69,000 miles of selectively operated telephone lines composed of 600 circuits with a total of 15,000 stations. The various ratios are, therefore:

Miles per station	4.6
Miles per circuit	115
Stations per circuit	25

Data collected on 14% of the total mileage gives the ratios of

Miles per station	5.4
Miles per circuit	117
Stations per circuit	22

Current is supplied to operate 145 circuits as tabulated:

	Dry cells	Storage	Dynamo	Primary
Main Signaling	121	19	5	..
Local Relay	103	28	..	4
Supervisor's Transmitter	49	36	..	60
Way Operator's Transmitter	144	1	..	..

Where dry cells are specified the six-inch cell is generally used, but 5 per cent of the total number being other than this size. Of primary (caustic solution), batteries 31 circuits use the 400 ampere hour, 33 the 300 ampere hour and 10 the 200 ampere hour type, while storage cells range from the so-called "5 ampere hour" to the "250 ampere hour" capacity. But one road uses storage cells for the four classes of service. Five circuits are supplied from dynamo with auxiliary "standby" dry battery. Booster sets (intermittently operated motor generators), are used on several circuits, but the number and other data is not available.

General Data.—Although there are many items which enter into the matter of selecting the ultimate best means of supplying signaling current, the initial cheapness, simplicity and flexibility of the dry cell are factors which rather confuse the idea that it is in the long run the cheapest. It would probably be proper to consider interest, maintenance, depreciation and even apportionment of space with rental charges before it can be definitely determined the most economical means for supplying current.

From the data collected it was found that where dry cells and primary battery are used the cells were worked very close to the ultimate ampere hour output. For example, the recorded life of dry cells on dispatcher's transmitter circuit was 21 days while computing from the calls per station per day at a discharge rate of .3 amperes, the life should be 20 days. In many cases the life of the signaling batteries as indicated by the number of renewals per year was close to the computed drain.

The average ampere hour consumption of current per year on over 100 selectively operated telephone circuits is 15.

Dry Cell Characteristics.—The 6-inch dry cell of the "high internal resistance" type, now available, will at a discharge rate of .12 ampere hour per day, deliver energy for 165 days before reaching the "cut off" point of .9 volts, when the short circuited reading will be close to 1½ amperes. Further, the shelf deterioration is at the rate of .02 ampere hour per day, which amount must be considered when computing the life of this cell for any given work. Thus, in 165 days, 20 ampere hours are delivered to the working circuit; while the cell in this time actually shows 23, since 3 ampere hours are consumed in shelf life alone; this energy, of course, is not available. The shelf life is, therefore, three years, or the quotient of 23 divided by .02. Temperatures above 70 degrees Fahrenheit tend to shorten the length of time which the cell will be serviceable, since the local action takes place more rapidly at higher temperatures, while below 70 degrees this action is retarded.

In the "high amperage" type the deterioration is at the rate of .05 ampere hours per day while an "ignition battery" will show .07. The 8-inch cell has double the output or 40 ampere hours of available energy, but the cost is 2½ times that of the smaller cell. If a selector circuit consumes current at the rate of .12 ampere hours per day or less, unquestionably the "high resistance" 6-inch cell is the most economical.

PRIMARY CELLS.

Signaling Battery.—If the "200 ampere hour" type is considered, one set would (theoretically) last 13 years.

Assuming the voltage required is 200, then 286 primary cells or 140 dry cells are needed. The dry cells would have to be renewed once per year or 13 times, or the cost for cells alone would be $315.00 (for 286 primary batteries), as compared with 1,820 dry cells at $273.00. With the usual carrying charges including installation expense, the respective total costs would be for the consumption of 15, 30 and 45 ampere hours per year as follows:

Dry Cell		Primary Cells	
1 renewal per year	$481.00.	15 amp. hrs. per year 13 years.	$600.00,
2 renewals per year	390.00.	30 amp. hrs. per year 6½ years.	461.00,
3 renewals per year	$362.00.	45 amp. hrs. per year 4⅓ years.	412.00,

On a basis of "service" the greater cost of the primary cell would not be considered, but the choice would otherwise still be with the dry cell; the operating conditions might change to render the primary cell impracticable, further the space required limits its flexibility.

Local Relay and Dispatcher's Transmitter.—For local relay and transmitter circuits in the supervisor's office these cells should be used irrespective of cost in preference to dry battery; the first cost is within $25.00 for both services where the "200 ampere hour" cell is used or $50.00 in the case of the "400 hour" cell.

Way Station Transmitters.—Consider one circuit which was reported as follows:

Conversations per day	36
Length in seconds	30
Battery, 6-inch cells	3
Renewals per year	2
Transmitter current Amp	.3
Ampere hours per day	.09
Shelf Deterioration (A. H.)	.02
Total Amp. Hours per day	.11
Battery Capacity (A. H.)	.23
Service to "Cut-off" Point, days	209
PRIMARY CELLS.	
Capacity Amp. Hours	200
Discharge rate per year (A. H.)	40
Computed life in years	5
Initial cost, six cells	$7.00

COMPARATIVE MAINTENANCE COSTS.

3 cells at 15c	$0.45
Renewals at 20c per cell	.60
2 Renewals per year	1.05
(a) $1.05 x 7 (years)	7.35
3 Renewals per year	1.65
(b) $1.65 x 4 (years)	6.60
4 Renewals per year	2.25
(c) $2.25 x 3 (years)	6.75

If the renewals per year on dry cells are more than two, the primary cell is the cheaper. The renewal cost of $0.20 per cell is obtained from data extending over a period of three years.

It is necessary, however, to systematize the method of renewal if primary cells are employed so as to keep the costs at the minimum. This can be done by having the electrolyte prepared by the manufacturer and shipped in carboys specially arranged to facilitate handling. The packing crate of the cells could be designed for a battery box. The maintainer could, for example, get between stations on a local freight train and if six extra cell tops are carried, these can be assembled en route so that the time required at a station would not exceed for two men, fifteen minutes.

Storage Cells.—The advantage of initial and operating costs of various capacities of storage cells may lie with the smallest type since for low rates of discharge and small capacities as are required for "selector service" the different makes are obtainable at prices such that the efficiency is the factor which decides the selection. Records of the upkeep on 2,500 cells extending over a six-year period show that the depreciation on the "5 ampere hours" cell does not exceed 10 per cent per year and that the maintenance charge is closely thirty cents per cell per year. This average was obtained by dividing the yearly salary of the maintainer by the number of cells under his supervision and not allowing for such time as he spends on other work. The average is, therefore, conservative in this instance.

If direct current is available it would be advantageous to use two sets rather than one with a motor generator set for charging, since the cost of the machine and power board will not be less than $190.00, which will buy 200 or more cells. By charging for short periods each day either set of cells may be used in emergencies. Also, the simplicity of the power board readily permits the local relay and transmitter batteries being charged without the attendant complications which would be present in a panel used in connection with a 250 or 500 volt motor generator set.

For way station transmitters the storage cell is hardly commercial. The one instance in which it is used is due to operating conditions where the cells (portable type), are all located within ten miles of the charging station and the train service is such that a replacement can be made within an hour at any station.

Rectifiers.—Mechanical, electrolytic or mercury arc rectifiers for charging, are either more expensive initially than a motor generator set or the design is such that the simplicity of the rotary converter is alone sufficient to decide in favor of the latter machine.

Owing to the characteristics of the current delivered by a rectifier it is not a practical means of supplying current direct to a selector circuit. The voltage could, of course, be stepped up and the current carrying capacity of the smallest type is amply large for the requirements of the heaviest circuit. There are, however, many other phases to the problem which cannot be here considered.

Direct Supply.—Dynamo current from "city service" for signaling, when used in connection with an auxiliary "standby" battery, may be used when the signaling device normally requires current of small value, as the commercial circuits rarely exceed 250 volts and this usually means a grounded neutral. If one circuit is operated from the "mains" the voltage may be regulated with a rheostat or the selector resistances tapered to compensate. If two or more circuits are to be fed from the same source, individual resistances can be cut in series with each line at the outside rather than the inside terminal of the reactance coil, or, all circuits may be tapered for the maximum voltage. This latter method is, of course, the proper one to use when conditions permit.

Machine Service.—Specially designed "booster sets" wherein a low voltage storage or primary source of current drives a motor generator set only when a calling key is operating, will cost more initially than two sets of storage cells or one set and a charging machine with power panels. Compactness and low operating cost are the chief advantages. In order to apply to existing circuits the calling keys must be arranged with an auxiliary control contact, although on low speed keys a slow releasing relay might be used to close the primary circuit on the first impulse. The dispatcher could also effect this by means of a foot switch, which method could not be used with an ordinary motor generator set unless sufficient time is allowed for the machine to attain full speed. This arrangement is further objectionable from an operating standpoint.

Continuous Running Machines.—Continuous running motor generators of 125 or 200 watt capacity have many advantages if used in conjunction with a "standby" battery. A reserve machine should be provided. The simplicity, flexibility, overload capacity, economy of space, minimum maintenance charge, low depreciation and first cost make this method of current supply preferable where the local conditions permit. The cost for power is the chief argument against their use. The actual total time the full load current is flowing in the "average" circuit is but 122 hours per year or 1.4 per cent of the total time. If a circuit requires 100 watts to operate and the motor absorbs 200 watts delivering this output at a cost $0.06 power rate the total cost per year for power will be $27.00, assuming that on no load the motor uses 25 per cent of the full load current.

A well designed machine with long bearings and commutator surface will run continuously one year or more without any attention other than filling the oil reservoirs and wiping off the commutator. Such attention does not require the services of a regular maintainer.

Considering the factors which enter into the selection of the method of furnishing signaling current and applying data obtained from a study of the various circuits, we may summarize with the "average circuit."

Voltage	200
Current	.12 amperes (interrupted)
Closed Time	3 seconds
Total Calls	400 per day (despatcher)

The current consumed per year is 15 ampere hours and the minimum watts 24. One set of dry cells (140), would therefore, allowing for shelf deterioration, last twelve months. The first cost would be $21.00.

The initial cost of the storage battery equipment includes power panels. To complete motor generator equipments, each of 125 watt capacity are covered by the item of $150.00. No installation charges are included. All power for operating is a $0.06 rate.

The comparative costs are, less terminal coils, etc. (Table 1):

TABLE 1.

	Dry cell	Storage 2 Sets Direct Charges	Cells 1 Set and Machine	Primary 200 AH.	Motor Generator	Booster
First cost...	$21.00	$150.00	$240.00	$315.00	$150.00	$400.00
Power		30.00	25.00	.....	27.00	10.00
Interest 5%	1.05	7.50	12.00	15.75	7.50	20.00
Depreciation.		15.00	24.00	.....	7.50	24.00
Maintenance.	12.00	60.00	40.00	5.00	5.00	5.00
Totals (end of first year.	$34.05	$262.50	$341.00	$335.75	$197.00	$459.00
Annual carrying and operating chrgs.	$34.05	$112.50	$101.00	$20.75	$47.00	$59.00

The 200 ampere hour primary cell is used in the above figures so that the total charges extend over a period of 13 years which, although an impracticable length of time, from an operating view point, nevertheless will show where the various current supply systems are comparable. The dry cell must be renewed 13 times. The respective total costs are then for this 13 year period as follows (Table 2):

TABLE 2.

	Dry Cells	Storage 2 Sets	1 Set and Machine	Primary	Motor Generator	Booster
First Cost..		$150.00	$240.00	$315.00	$150.00	$400.00
Carrying Charges 13 years	..$443.00	$1,463.00	$1,313.00	$269.00	$611.00	$767.00
Total	....$443.00	$1,613.00	$1,553.00	$584.00	$761.00	$1,167.00

If auxiliary "standby" dry cells are to be used with a motor generator set the total cost for 13 years should be increased to $1,020.00.

These figures being based on the "average" circuit and with certain assumed charges, are not of much value, but by using the first costs which are sufficiently accurate to apply, reliable comparative costs are obtainable using such fixed charges as are determined by local conditions.

The following (Table 3) compiled from the data sheets shows the ampere hours required per year to operate 12 typical circuits:

TABLE 3. AMPERE HOURS REQUIRED PER YEAR.

	1	2	3	4	5	6	7	8	9	10	11	12
Voltage	165	182	300	180	190	125	240	140	212	222	350	240
Calls per day	150	200	250	350	500	500	600	800	600	600	600	500
Number of selectors	18	30	21	21	23	25	28	44	36	34	48	47
Current per selector	.008	.008	.01	.01	.01	.01	.01	.004	.008	.01	.008	.01
Maximum current	.16	.272	.21	.21	.23	.25	.27	.205	.29	.34	.385	.47
Interrupted current	.095	.136	.15	.15	.115	.12	.11	.102	.145	.18	.197	.24
Closed time, seconds	2	2	2	3	3	3	3	3	3	3	3	5
Ampere hours per year	3	5	7	16	17	18	20	24	26	32	36	60
Watts	26	49.5	63.	37.8	43.7	31.3	64.8	14.7	61.5	75.5	134.8	112.8

Average ampere hours, 22. Average watts, 60.

An inspection of 145 circuits showed none which required more than 150 watts to operate and but 15 using more than 110, indicating that the large majority of circuits are well within the capacity of a 125 watt motor generator set and that this size could be overloaded to handle the heaviest circuit. The average in the above 12 circuits being 60 watts, one machine of 125 watt normal rating would be large enough for any of the two circuits except No. 11 and No. 12.

The 12 circuits offer a sufficient number of different values so that any proposed circuit might readily come under one of them. From the other tables given it is possible to determine which method of supplying signaling current will be best suited, whether or not the usual overhead charges are supplied.

No attempt is made to give detail figures on either local relay or supervisor's transmitter battery. If storage cells are used in the signaling circuit they should be used throughout, or primary cells rather than dry batteries if conditions preclude the use of storage cells in this service.

Chicago and Alton Telephones

A gang of workmen of the Chicago & Alton's telegraph department have been sent out of Bloomington, Ill., to work north, doing preliminary work for the installation of the new telephone dispatching system on the north end. The authority for this work was received some time ago. Another gang has been placed at work installing arms and transpositions. The work will be completed in a couple of months' time and will complete the telephone dispatching system from Chicago to St. Louis over the Alton main line.

Western Maryland Uses Telephones

The Western Maryland Railway Company is getting highly satisfactory results from the new telephone system of dispatching trains, which was recently installed on the company's lines between Hagerstown and Cumberland, Md. The substitution of the telephone for the Morse system in train operations on the portion of the line referred to was decided upon some months ago by President Fitzgerald, and steps were at once taken to make the new service a reality.

The latest system has been in operation for several weeks and has proved a big success. The chief executive of the Western Maryland stated at the time that a decision was reached to replace the Morse system with the telephone, that more efficient service would be obtained, and Mr. Fitzgerald's prediction has turned out to be true in every sense of the word. Traffic between Hagerstown and Cumberland is heavy at all times, and there was ample opportunity to test the usefulness of the telephone where train movements were concerned. Its use has increased the operating efficiency in every respect.

One advantage of the telephone system for dispatching trains is that it enables the train crew to keep in close touch with the dispatcher's office. Telephones have been installed at all sidings, and the conductor of a train can get into quick communication with the dispatcher's office by telephone. This was not possible under the old system. Headquarters could only be reached at a point where there was a telegraph office and an operator on hand to send the necessary message.

A report from an American consular officer in Asia states that owing to the present unsatisfactory telephone service in a large city an officer requested to be placed in touch with an American company that would be prepared to install a modern telephone system.—File No. 11319, Bureau of Manufactures, Washington.

Inductive Disturbances on Telephone Lines

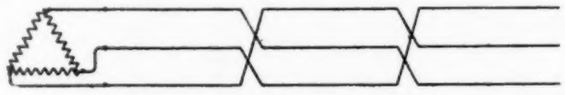
By P. J. Howe*

PREVENTING AND OVERCOMING INDUCTIVE DISTURBANCES.

THE solution of inductive problems divides itself into two lines of investigations, one with reference to prevention and the other to restriction. The means of prevention naturally apply to the power systems, and those of restriction to the disturbed systems.

If it were always possible to learn at an early date of proposed power line or electric railway construction in the vicinity of our telephone or telegraph lines, it would often be practicable, through negotiations with the power engineers, to have those lines so located and operated that they would not interfere with our weaker systems. But when a power system is nearing completion or already in operation, it is a much more difficult proposition to have it modified so as to prevent the inductive effects. In such cases, the disturbances can be more or less restricted by modifications of the telephone and telegraph systems. Prevention, however, is always more desirable than restriction, if practicable and economical.

Investigating Inductive Disturbances.—The first step in the solution of induction problems is to obtain com-



TRANSPOSITION IN THREE PHASE LINE

Fig. 8. Transposition in Three Phase Line.

plete information about the disturbed and disturbing systems, and their parallelism.

Information about the line parallelism can be best recorded and shown in the form of drawings. These drawings should show the exact sections of line subject to disturbances and the separation of the lines at all points. The number and size of wires on the telephone or telegraph line, and on the disturbing line, should be noted and also the location of all taps, loops, apparatus or other changes in the wires of either system. Any transpositions in the power wires or telephone circuits should also be located and noted.

Data about the power system should show character and number of circuits, their respective locations on the line, their voltage, the method of operation, and the presence of grounds on any of the circuits. Also the character and amount of load and, where it happens to be an electric railway, the schedule of cars or trains from which the variation in load can be determined. In the case of the railways, the amount of current per car and per train is important.

Relative to the telephone and telegraph systems, the investigations should show the character of all the circuits, the kinds of apparatus used on them and the service to which they are assigned. In cases where the power line is already in operation, tests should be made to determine the seriousness of the interference and the voltage and strength of the induced currents. The character of induction, whether static or magnetic, and, in a general way, whether the induction is principally from fundamental or harmonic currents, should be determined.

From the results of such an investigation as described above, it will usually be possible to determine what are the controlling factors of the problem, and what, if any, modifications of the power lines or apparatus or of the telephone or telegraph plant, will overcome the disturbing effects.

PREVENTION BY MODIFICATION OF POWER SYSTEM.

Separation of Lines.—Distance is the surest preventative of induction troubles. If all alternating current lines were located a reasonable distance from telephone and telegraph lines there would be no such things as inductive disturbances. But "reasonable distance" is an indefinite term. It varies with the opinions of different observers, and it depends a great deal on the character of the disturbing circuits. It is therefore impossible to fix any minimum distance or set of distances which a power line must be from a telephone line, or a telegraph line, in order not to cause disturbances. In any particular case, however, there should be no trouble in deciding upon a reasonable figure if the engineers of the two systems "get together" before the location of the second line is definitely chosen.

Insulation.—Whatever the type of a power circuit, its line insulation has a very considerable effect on the inductive disturbances caused by it. A broken insulator or a wire touching a limb of a tree, or any other object, will usually cause a leak to ground. If there are no other grounds on the circuit, this one point of low insulation will raise the potential to earth of the entire circuit and upset its static balance. As a result, the neutralizing effect of the two or three wires of the circuit will be destroyed and static disturbances in neighboring wires will be multiplied many times. Moreover, there may be a considerable current flowing to ground, if there happens to be another ground on the circuit, as, for example, at the generator or transformer, or at some other point of poor insulation. In such cases, the currents in the system will become unbalanced and electromagnetic disturbances will result. As hereinbefore mentioned, the effect of an accidental ground on a lighting or power circuit may be very far reaching, by reason of that circuit being tied in to several other circuits at the power house bus-bars.

Constant Potential Distribution Systems, Single Phase.—Single phase distribution circuits are troublesome principally to telephone systems. The conditions which can be modified with corresponding effects on the telephone circuits, are the location of the disturbing wires with respect to each other, the location of transformers, taps, etc., the location of transpositions and the balance of the circuits, both static and magnetic.

It is desirable that the wires be as close together as practicable. That is, they should be on adjacent pin positions, and not on different crossarms or on pins at the two extremities of an arm. Where a single phase circuit includes a third or "neutral" wire, the transformers, taps, or other loads should be so located and connected that the currents will be as near in equilibrium as possible, and the system balanced.

Induction in paralleling wires can often be elimi-

*Concluded from July. Paper read before the annual convention of Association of Railway Telegraph Superintendents.

nated by transpositions in the power circuit, that is, by interchanging the pin positions of its wires. In order that transpositions may be effective, it is necessary that all exposures to the power circuit in one of its positions be equal to the exposures in its transposed position. For this reason, it is desirable that the circuit maintain its same position on a pole line throughout its entire exposure to foreign circuits. In locating transpositions, all transformers, attachments, abrupt changes in parallelism, etc., are regarded as points of discontinuity and the intermediate length of line divided by transpositions into an even number of uniform sections. If the parallelism to the telephone line is uniform, the transpositions will be located equal distances apart. If the parallelism varies, the separation of transpositions will be increased as the separation of the lines increases. The location of transformers, taps, etc., and of transpositions in the power wires, serve also as a basis for the location of transpositions which are usually placed in the telephone circuits. When any of these conditions are altered, it is possible that the efficiency of the remaining transpositions in both lines will be greatly reduced. Therefore it is desirable that all points of discontinuity on a circuit remain unchanged after they have once been established, and that the various conditions of the two systems be kept in mind whenever it is necessary to relocate taps and transformers or add new ones.

Series Arc Lighting Systems.—Alternating current arc lighting circuits cause much greater induction on paralleling wires than the single phase disturbing circuits. Like the latter, however, they are troublesome chiefly to telephone systems. Arc light induction is principally static and is generally the result of an unbalanced line. As shown in Fig. 3 (July issue) the lamps are liable to be irregularly spaced and, to a large extent, connected into one side of the circuit. One side is also liable to be looped into a street, or perhaps down one street and back on another, circling an entire city block or district. These conditions result in the potential to earth of adjacent wires being very different and not always of opposite polarity. Consequently there will be only partial neutralization of the induction. Where only one side of a circuit is carried on a line there is practically no neutralization of the effects on paralleling wires.

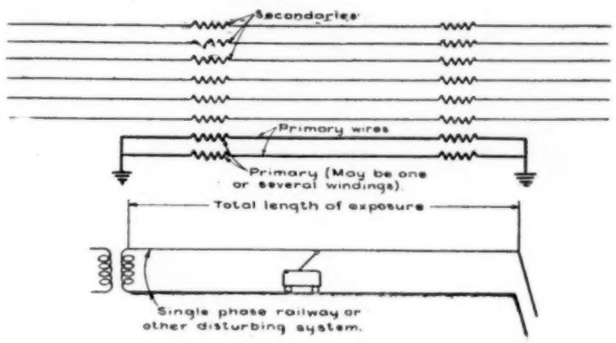
The least troublesome circuit will be one in which the two wires are always close together and balanced. The lamps should be connected into both wires so that the adjacent wires on the line will be as nearly as possible at equal and opposite potentials to earth. Such a circuit is shown at *A*, Fig. 3. More perfect neutralization will be obtained if the circuit is transposed between adjacent lamps, as shown at *B*, but this arrangement is often impracticable on account of close spacing of lamps. Arrangement *C* is bad, by reason of adjacent wires having very different potentials to earth. Arrangement *D* is typical of many installations, and in some sections is very liable to cause troublesome induction. Probably the worst type of arc circuit is one which leaves a power station in one direction and returns from another, with the two sides of the circuit always carried on different lines and far apart.

In all cases of arc light induction, a ground on the circuit will greatly increase the disturbances in other lines. It is also probable that the effect on telephone circuits is increased by high frequency currents caused by the arc lamps themselves.

Three Phase Systems.—What has been said above with reference to the insulation and balance of distribution and lighting circuits applies with equal force to three phase systems. Induction from the fundamental voltages and currents of a three-phase line can be more or less eliminated by transpositions in the power wires, if the system is balanced. With an unbalanced system, transpositions will be only partially effective.

A transposition in a three phase circuit consists of three partial, or 120 degree transpositions, made as shown in Fig. 8. At each transposition the wires are turned over, or spiraled, always in the same direction, so that they will occupy successive positions in successive sections. The action of the transpositions is similar to that of transpositions in single phase circuits. That is, with equal exposures in all sections, the induction caused by each power wire in one section will be neutralized by the induction from the other two wires in the other two sections.

The same principles that apply to single phase circuits apply also to the transposing of three-phase circuits. A transposition section should terminate at points of discontinuity, in either the power circuit or disturbed circuits, and should embrace as uniform an exposure between the two systems, as practicable. If the parallelism is of considerable length, it will often be necessary to provide a number of transposition sections. Therefore


Secondaries
Primary wires
Primary (May be one or several windings)
Total length of exposure
Single phase railway or other disturbing system.

COMPENSATING TRANSFORMER SYSTEM

Fig. 9. Single Phase System with Auto-Transformers.

the transposing of a three phase line consists of dividing the exposures between points of discontinuity into three lengths, or some multiple of three, and installing 120 degree transpositions at the ends of these lengths. The number of complete transpositions required depends on the length of the exposure and the severity of the disturbances. The spacing will be uniform, where the exposure is uniform, and will increase where the separation of the power line from the disturbed line increases.

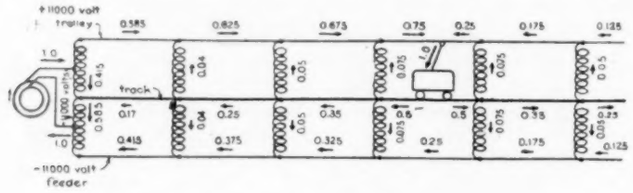
About a year ago the initial operation of a 140,000 volt three-phase line induced potentials of over 2,300 volts in some neighboring telegraph wires. The parallelism was about 30 miles long and the disturbances were largely electro-static. Installing one complete transposition in the power wires reduced the induction to from 500 to 600 volts. After six transpositions had been installed, comprising seventeen 120 degree transpositions located 1 2-3 miles apart, the disturbances averaged from 20 to 30 volts.

The method of operating a three-phase system largely influences the amount of interference with neighboring lines. From the standpoint of inductive disturbances, the principal differences between the delta

and the "Y" methods of operation may be described as follows:

On a system operating with "Y" transformers, the triple harmonics caused by the generator or transformers appear as single phase voltages between the line wires and neutral. Where the neutral is not grounded, this harmonic voltage may not appreciably affect other wires. But when the neutral is grounded, the triple frequency voltages appear as single phase voltages to ground and may induce heavy static disturbances in paralleling lines. Furthermore, this high frequency interference can not be neutralized by transpositions in the power wires, on account of all triple harmonics being in phase. In a delta system the triple frequency currents are short circuited by the transformers themselves, and are therefore not liable to cause induction on neighboring lines. There is no neutral available when transformers are connected in delta. On a system operating with grounded neutral at the generating end, it is possible to so ground the neutral at the distant end that triple frequency currents will flow out over the line wires in parallel and return by ground. This condition will exist when the step-down transformers are operated with line side "Y" connected, neutral grounded, and low tension side delta connected. It would result in practically no static disturbances but might cause magnetic induction, instead.

When a ground occurs on one of the wires of a delta system, or a "Y" system having an ungrounded neutral, the potential of the other wires to ground will be raised to the full line voltage and static disturbances in other wires will be increased many times. A line



Single Phase System with Auto-transformers

Fig. 10. Compensating Transformer System.

failure on a system having a grounded neutral will also greatly increase the static disturbances, but not as much as when the neutral is ungrounded. It may, however, so disturb the magnetic balance of the circuit as to cause magnetic induction in paralleling systems.

As a result of the various conditions described above, delta transformers are always to be preferred where telephone or telegraph lines are operated in the near vicinity. The principal reasons for this are that they practically eliminate the triple frequency currents and voltages from the line and provide no neutral which can be grounded. Where "Y" connections must be used, an ungrounded neutral will, in general, result in less induction on paralleling low tension systems.

Single Phase Electric Railways.—The single phase railway is operated with one terminal of the generator or transformer connected to the overhead trolley conductor and the other to the steel rails and earth. There is no conductor of opposite polarity carrying current in the opposite direction, as in the metallic single phase distribution systems, and hence no neutralization of the inductive effects on other wires. For this reason, the large currents used in railway work induce very high potentials in paralleling telephone and telegraph wires, often amounting to hundreds of volts.

Most of the disturbances from single phase railways are due to electro-magnetic induction. The magnitude of the induction depends to a large extent on the amount of current which leaves the track and returns through the earth. For this reason it is very important that the return rails be well bonded and maintained, so as to reduce the earth current to a minimum. Good bonding of rails will also tend to prevent direct leakage to other systems which work to ground in the exposed district.

Interference from single phase induction could be largely reduced by providing an arrangement of circuits which would carry the return current in conductors located close to the trolley and feeder wires. There have been various schemes suggested for this neutralization, but most of them are more or less objectionable to the railway people, either on account of increased expense for transformers and line conductors or on account of some sacrifice in reliability of operation. Some of the simplest or more promising schemes are described in the following:

Where a telephone or telegraph line is exposed over a considerable distance, magnetic disturbances can be decreased by supplying current to the trolley at frequent intervals from transformers fed by a common high tension supply circuit. The decrease in induction would result from a car drawing current from two directions, that is, from the two nearest transformers. If a car is midway between any two sub-stations, equal currents will flow in the trolley for equal distances but in opposite directions, with a consequent neutralization of inductive effects. If the car is nearer one sub-station than the other, a greater current will flow over the shorter distance, and the neutralization will still be effective.

A modification of the last described method consists of cutting the trolley circuit into short sections, each one fed by a transformer. Although this will limit the length of the sections causing interference it will not provide the neutralizing effect for these sections. The latter can be obtained by using a transformer at each end of each trolley section, or what is its equivalent, one transformer with two secondary windings at each break in the trolley. If any effects from static induction are present, they can be largely neutralized by reversing the polarity of alternate sections of trolley.

One of the most promising schemes for restricting single phase railway induction, both static and magnetic, is an arrangement which is now being installed in the electrified zone of the New York, New Haven & Hartford Railroad, near New York City. As shown in Fig. 9, 11,000 volts will be used as heretofore, but the 11,000 volt power will be first stepped up by an auto-transformer to 22,000 volts. The middle point of this transformer will be connected to the track and earth. Of the outside terminals which now become + 11,000 and — 11,000 volts respectively, one will go to the trolleys and the other to auxiliary feeders. At certain intervals, auto-transformers will be connected between the trolleys, feeders and tracks, as shown. These transformers serve to so distribute the current taken by a car or train that only a part of it will flow in the tracks beyond the adjacent transformers. In parts of the New Haven system, autotransformers will be spaced approximately two miles apart; in other sections, where the load is less, a greater spacing will be used. The figures and arrows in Fig. 9 represent the approximate distribution of current in the various parts of a system such as illustrated. It will be seen that the currents in the trolley and feeder flow in opposite directions and will therefore considerably neu-

tralize the magnetic induction on paralleling wires. The greatest disturbances will take place in the sections nearest to a car, for in this vicinity the trolley and feeder wires will be more unbalanced and the track current greater than elsewhere. A certain amount of neutralization will also be caused by the track currents flowing in opposite directions from a car. The arrangement described will practically neutralize all static induction, by reason of the trolleys and feeders having opposite and equal potentials to earth.

Although the auto-transformer system of single phase operation will not provide as complete neutralization of inductive effects as some of the other schemes hereinbefore mentioned, it has several points in its favor, from the railroad point of view. It approximates a system having twice the trolley potential, with consequent economies in line copper. No wires, however, have a potential to ground greater than that of the trolley itself. The auto-transformers may be of relatively small size, as the load on a single transformer is never more than a small part of the total load taken by a car or train. A further advantage of this scheme is that it can be more easily and cheaply applied to existing systems than can other arrangements for neutralizing induction.

Harmonics and Irregularities.—Harmonics and irregularities in disturbing circuits have been mentioned in several parts of this paper. In summarizing these conditions, it may be stated that harmonic currents are liable to exist in all types of alternating current systems. As their elimination or suppression will sometimes be the means of overcoming inductive interference, the following is given with a view to explaining how the presence of harmonics, and their frequency, may be determined, and to suggesting how they may be overcome.

The presence of harmonics and their approximate frequency can be determined by the tone or sound which the induced currents will produce in a telephone receiver. If there are a combination of noises present, however, it will be difficult to decide what is the predominant tone. The tone in the receiver depends on the frequency. Middle "C," on a pianoforte, corresponds to about 256 cycles per second. Ascending the scale, the next octave represents 512 cycles, the next 1,024 cycles, etc. For descending tones, the first octave below middle "C" represents about 128 cycles, the next 64, etc. Intermediate notes will have intermediate frequencies. When investigating the frequency of inductive disturbances, the harmonics that would be expected are the third, fifth, possibly the seventh, and their multiples. For example, harmonics in 25 cycle systems might have frequencies of 75, 125, 175, 225, etc., for 60 cycle systems the corresponding frequencies would be 180, 300, 420, 540, etc. If the tone from a disturbance is about the same as the note corresponding to one of these frequencies, it may be assumed that that harmonic is more or less prominent in the disturbing power circuit.

The elimination of harmonics from a power circuit is a problem for the power engineers. Where a power system will permit of it, short circuiting the harmonics at the generator or transformer will probably be the simplest method. A small capacity condenser, designed of course for the power voltages, should be satisfactory for this. A better arrangement, however, would be a circuit of inductance and capacity, adjusted for resonance at the frequency which it is desired to eliminate. In one example of this method, conditions in a telephone system, disturbed by a single phase railway, were very considerably improved by short circuiting the railway generator with a resonance of 550 cycles, this being the predominant frequency of the disturbances. Whenever power harmonics are short circuited in this manner, it is, of course, necessary to guard against the creation of large harmonic currents which may be injurious to the generating plant.

Besides the short circuiting method of eliminating harmonics from line conductors, as described above, it may sometimes be possible to prevent the high frequency voltages by removing or altering the conditions which first cause their generation.

Restriction by Modification of Telephone or Telegraph Systems. General.—Inductive disturbances in telephone and telegraph systems cannot be entirely eliminated by modifications of those systems alone. Their complete prevention can only be brought about by removing the cause. When interference is slight, however, the serious effects can be more or less overcome by special apparatus or modifications of the low tension system, or by providing additional conductors. Theoretically, telephone circuits can be so balanced as to be operative under any exposure to inductive influences. The practical limit of satisfactory operation, on the other hand, is very soon reached when induction is present. In certain cases of magnetic induction, also, very considerable induced currents can be compensated for, but the neutralization is never complete and the procedure is, relatively, quite expensive. In the following are given the principal methods of modifying telephone or telegraph circuits, for the restriction of inductive disturbances.

Insulation.—Just as the insulation of a power circuit affects the inductive disturbances caused by it, so does the insulation of a telephone or telegraph circuit influence the magnitude of disturbances on it. In order to restrict the effects of power interference, it is first essential that the disturbed circuits be maintained with a high line insulation. In the case of grounded telegraph circuits, leakage may tend to impair the efficiency of any neutralizing devices which are used on the circuits. It is probable, also, that leakage may be a direct source of power disturbances, if the power lines happen to be at all low in insulation. Metallic telephone circuits exposed to inductive influences are especially sensitive to low insulation. When a circuit is well insulated, it can be balanced by transpositions, so that the induction on the two sides will be alike, and practically none of the induced current will flow from one side to the other. When the wires become leaky, or one wire has a somewhat lower insulation than the other, the circuit becomes unbalanced and the induced currents in the two wires will no longer be equal. The result will be a strong current flowing between the two wires, and consequently, a noisy telephone circuit.

For the reasons given above, the first procedure in attempting to overcome inductive disturbances should be to go over the line and remove all sources of low insulation, such as limbs of trees, strings or broken branches across the wires, broken insulators, etc. This applies not only to the exposed section of line but to all sections of the exposed circuits.

Transpositions.—On account of having a ground return, telegraph circuits can not be transposed against induction. In the case of telephone circuits exposed to induction, all regular transpositions should be checked up and any that have been omitted or incorrectly located should be corrected. If the ohmic resistances of the two sides of a circuit differ appreciably from each other,

it will sometimes be necessary to locate and remove the sources of difference, such as bad joints and wires of a different size. After these procedures, the possibility of installing special transpositions in the telephone circuit can be considered if the induction is still troublesome.

The principles to be observed in transposing telephone circuits are the same as those hereinbefore described with reference to transposing power circuits. The procedure is first to divide the exposed line into sections of as uniform exposure as possible, and then to install transpositions at the ½, ¼, ⅛, etc., points of these sections. There should be no apparatus on or changes in either the telephone or power wires in the sections being transposed. The ends of the transposition sections should be at points where either the parallelism changes, the power line is transposed or the regular telephone crosstalk transpositions are located, or where apparatus, loops or taps are connected to either the telephone or power wires. The special transpositions need be installed only in those circuits which are most seriously affected by induction, unless these extra transpositions upset the crosstalk balance to the other circuits on the line. In such cases it will be necessary to transpose all other circuits at the same poles.

When the exposure of a telephone line to a power line extends over a considerable distance, better results can sometimes be obtained by an entire retransposition of the line, than by the special transpositions described above. Instead of having regular crosstalk transposition poles located at the usual one-quarter mile spacing, special short sections should be installed with the transposition poles spaced much closer together than usual. These sections should contain the regular crosstalk transpositions, and thus the crosstalk balance between the circuits will not be disturbed. At the same time, the transpositions on each circuit will be so much closer together than formerly that the effects of induction should be materially diminished.

Where very serious interference is encountered, the effects on telephone circuits can be greatly relieved by carrying the circuits in twisted pair wire or cable. The frequent transposition of the pairs will be very effective in balancing up the circuits, if the circuits are not elsewhere unbalanced by low insulation. It should always be borne in mind, however, that both cables and twisted pair wiring introduce a considerable transmission loss in telephone circuits, and are therefore undesirable unless the induction can be overcome in no other manner.

Shielding.—None of the procedures described above will eliminate the induced currents in the line wires. They merely tend to balance a circuit so that the inductive effects will be less serious. Where inductive effects are caused by electro-static induction, it is possible to practically prevent the formation of induced currents by placing the wires in a cable having a grounded metallic sheath. This will shield both telephone and telegraph wires from static effects, but is objectionable on account of the resultant transmission losses mentioned above.

A number of investigators have suggested the installation of a grounded shield wire on a pole line, close to the telephone or telegraph wires. Although the writer has never seen any effectual neutralization brought about in this manner, the scheme is perhaps worth trying. Theoretically, a grounded wire should have some shielding action against static disturbances.

Electro-magnetic induction can be only slightly neutralized by shielding. Even placing wires in lead sheathed underground cable will not be effective in preventing magnetic disturbances, such as are caused by single phase electric railways.

Compensating Transformers.—When interference is caused by electro-magnetic induction it is possible to overcome much of the disturbance by compensating transformers, otherwise known as compensators. A compensator is a transformer having one or more primary windings, and as many secondary windings as there are wires to be compensated. The method of connecting compensators into telephone or telegraph wires is shown in Fig. 10.

One or more wires on the pole line, depending on the conductivity required, are connected through the primary windings and thence to ground at the ends of the exposure. The line wires which are to be compensated are run through the secondary windings. The voltage directly induced in the primary wires by a paralleling power or railway circuit causes current to flow through these wires to ground at each end of the exposure. This flow of current through the transformer primaries induces a voltage in each of the secondary windings. If now, the transformers have the proper ratio of primary to secondary turns, and the secondary windings are connected in circuit so that their voltages will oppose the voltages directly induced in the line wires, the disturbance in the secondary wires will be practically neutralized and the induction overcome.

In practice, the ratio of primary to secondary turns is from 0.85 to 1, to 0.95 to 1, the slight difference being necessary to take care of the impedence drop in the line conductors. The efficiency of a compensatiing transformer system can be made as high as 75 per cent, and even somewhat higher, if the conductivity of the primary conductors is made high enough. The compensation will never be perfect, however, on account of varying load, varying line insulation, phase distortion and partial magnetization of the transformer cores by earth currents or by the direct currents used on telegraph circuits. Compensating systems also have the disadvantage of being very expensive, on account of the cost of compensators and the wires used for primary circuits, and of greatly increasing the maintenance cost of the circuits affected.

Special Apparatus on Telephone Circuits.—After disturbances have been eliminated from the line conductors as completely as practicable, still further neutralization can sometimes be obtained by changes in the terminal apparatus. As hereinbefore mentioned, a telephone circuit may be well enough balanced to be operative, even when carrying very strong induced voltages. In such cases, however, it is desirable to drain off the induced currents so as to avoid the frequent operation of protector apparatus and the danger of physical shock from contact with the live parts of the circuit. This draining can be effected in a number of ways. The one best suited to any particular case can be best determined by actual experiment. Resistances or small condensers bridged to ground will sometimes improve a circuit, but they are also liable to greatly increase the transmission losses. Resonant circuits adjusted for the frequency of the disturbing currents and bridged to ground from each side of the line, will be more efficient in draining off induction and will cause less transmission loss. Other methods of draining a telephone circuit are to bridge it with impedence, having its middle point grounded, or to include a repeating evil in the circuit, with the middle point of its line side grounded. Equipping a telephone

circuit with any of the above devices may either increase or decrease the noise on the circuit, depending on how the balance of the circuit is affected.

In general, any drainage apparatus should preferably be located just outside of the exposed section of line, although it will frequently be just as efficient if located at the terminals of the circuit. Where induced currents are largely of a fundamental frequency, that is, of a frequency very different from the frequency of telephone currents, their interference with a telephone circuit can often be greatly reduced by simply bridging the circuit with a low resistance impedence. The writer has seen telephone circuits, over which conversation was absolutely impossible on account of induction, rendered usable by bridging a common 4 ohm telegraph sounder across the circuit or the telephone receiver. By reason of its high impedence to telephone frequencies, the sounder was not a very serious shunt on the circuit, but it offered little impedence to the induced currents, which in this case were largely 60 cycle.

Special Apparatus on Telegraph Circuits.—The frequency of telegraph impulses is often so near that of the induced currents that the restriction of inductive effects on telegraph circuits by changes in the terminal apparatus is not a simple matter. Either condensers or resonant circuits bridged to ground may be used on telegraph circuits, but care must be taken to insure that the draining device will not also interfere with the telegraph currents. Resonant shunts adjusted for the frequency of the disturbing currents and bridged to ground at the two ends of an exposure will considerably decrease disturbances on a telegraph line. Twenty-five cycle shunts, however, may cause a considerable drag on telegraph circuits, since these shunts will also be more or less resonant to ordinary telegraph frequencies. Single Morse circuits are much less interfered with by drainage devices, than duplex circuits, whose normal operating current is practically an alternating current. In the case of duplex circuits, it is probably better to connect the resonant shunts around the receiving relay, instead of between line and ground. When single Morse circuits have intermediate stations in exposed sections, the effect of induction on the intermediate relays may be reduced by shunting the relays with resonant circuits.

A common method of increasing the margin of operation on circuits subject to induction is to increase either the voltage or current on the telegraph line. This procedure has numerous objections, however, among which may be mentioned an increased interference, through inductive effects, with any high speed circuits which may occupy the same cables or pole line. Another neutralizing scheme which has been suggested and tried out with more or less success is to use the back contact of a relay, with a reversing sounder. It has also been proposed to have relays provided with neutralizing windings, operated from small neutralizing transformers.

In considering methods of shunting, choking or neutralizing induced currents in telegraph circuits, it must be borne in mind that any apparatus which affects the induced currents will also influence the telegraph currents themselves. The direct impairment of a telegraph circuit by special shunting devices increases as the frequency of the signaling currents approaches that of the disturbing currents.

Metallic Telegraph Circuits.—Probably the most effective and also the most expensive method of restricting inductive effects in a telegraph system is to convert the circuits over to metallic working. Any two wire metallic circuit will be less sensitive to induction than a circuit having earth return. Therefore disturbances may often be overcome by merely providing a return wire for each circuit.

It seems as if the best plan from all viewpoints, will be for the power engineers to make some concessions in the arrangement of their systems, which will prevent or reduce interference, and the telephone and telegraph engineers to employ whatever means are available for the protection of their delicate systems against the interference which the power engineers can not avoid.

In conclusion, then, all parties who are in any way interested in the maintenance and operation of telephone or telegraph lines should be ever on the alert for new power or electric railway systems. We believe, also, that the power engineers should be on the lookout for troubles caused by their systems and should notify the telephone and telegraph companies whenever power systems are proposed that may interfere with their service. The telephone and telegraph people should present their cases early to the power engineers or interests, and then should co-operate in endeavoring to form plans by which all interests can be served and the various companies live together with friendly regard for each other's welfare.

Denver and Rio Grande in Line

The telephone probably will replace the telegraph for dispatching work on the Denver & Rio Grande system, according to an announcement made by Vice President Brown of that company.

Construction gangs will start at once installing a special and private telephone system between Grand Junction, Colo., and Ogden, Utah. For this purpose, two heavy copper wires will be strung a distance of 328 miles, at an expense of upward of $50,000. It will require between sixty and ninety days to complete the work.

This system makes it possible to establish instantaneous connection between dispatching headquarters and trainmen. Not only will side tracks and blind sidings be equipped with telephone boxes, but all trains will carry the instruments, enabling trainmen to make connection at any point between telephone stations. Delays to trains occasioned by unlooked for interruption of any character will be minimized and the dispatching of trains expedited far beyond present possibilities. The heavily worked telegraph wires will also be relieved of much of their present burden.

Telephone Rebates Used for Auditorium

Letters are being sent out to 6,000 or more subscribers of the Cumberland Telephone Company by the Louisville, Ky., Commercial Club, asking that any claims they may have against the company for overcharges be assigned to the club in trust as a nucleus for an auditorium fund. Letters have been sent to those having claims of $80 or more.

About $137,000 in excess of the amount it would have received under the ordinance rates for telephone service has been collected by the telephone company, it is said. If this amount be given to the auditorium project it will practically assure its erection.

About a year ago a movement looking to the erection of a great public auditorium in Louisville was started and a site was obtained in East Broadway.

Of Interest to the Trade

Uses of Storage Batteries

The remarkable accomplishments of electricity are too well known to require comment, but many readers do not appreciate the part that has been played by storage batteries in the development and use of electrical apparatus.

The Crocker Land Expedition, under the auspices of the American Museum of Natural History, the American Geographical Society, the University of Illinois and other institutions, is sailing from New York City to explore the North Polar regions. One of the interesting features of this expedition's equipment will be a complete electric lighting plant which will be installed in a portable house at about 80 degrees North latitude. This lighting plant will be equipped with an "Ironclad-Exide" battery so that electric lights will be available at all times and it will only be necessary to run a kerosene engine occasionally to charge the battery. The electrical apparatus of this expedition will be in charge of Ensign Fitzhugh Green, U. S. N.

This "Ironclad-Exide" battery will be composed of 20 trays weighing 1,720 pounds, and having sufficient electrical capacity to light 115 eight-candle power lamps for ten hours.

This type of battery was chosen on account of its reliability, light weight and its ability to give good service at very low temperatures.

The digging of the Panama Canal, which is to be opened this fall, has been done largely by electrical machinery in connection with which storage batteries have been used. The batteries chosen by United States Government engineers for this service have been of the type known as the "Chloride accumulator" and even at the high temperature experienced in this tropical region have given most satisfactory service. These facts demonstrate that storage batteries of the proper types will operate satisfactorily in either very cold or very warm climates. The Chloride accumulator is also used in connection with wireless apparatus and for electric lighting and power service.

The government in its various departments has extensively studied and experimented with storage batteries and utilizes them for numerous purposes. Submarine boats of the navy, when submerged, are propelled through the water by current furnished from storage batteries. War ships use storage batteries for firing large guns and depend upon them for the emergency operation of wireless apparatus. Vessels of the navy as well as fortifications on land are provided with storage batteries as an emergency outfit for furnishing electric lights. In the post office service and at many navy yards the government uses electric motor cars propelled by storage batteries. For all these services the storage batteries manufactured by the Electric Storage Battery Company of Philadelphia are used.

Twenty submarine boats of the navy are equipped with "Exide" batteries made by this company—"Exide" batteries being also used for gun firing. For electric vehicle service "Exide," "Hycap-Exide," "Thin-Exide" and "Ironclad-Exide" batteries are used. These batteries have different characteristics, so that with one of the four it is possible to meet any demands of electric vehicle users. "Exide" batteries have for years been standard equipment with nearly all electric vehicle makers.

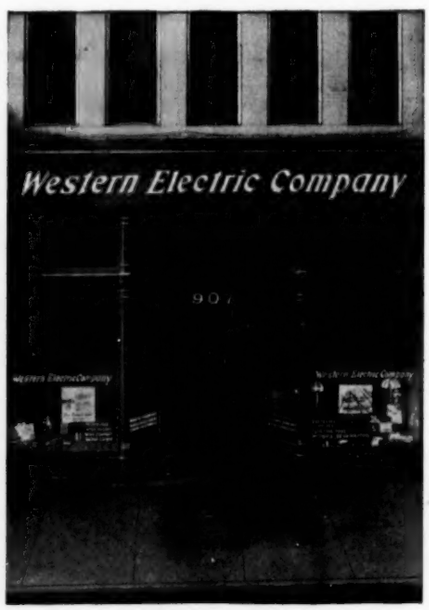
Storage batteries are constantly finding many new and popular uses, such as for starting and lighting automobiles, and, therefore, a little storage battery knowledge is well worth while.

The Electric Storage Battery Company claims to be the oldest and largest storage battery maker in the country. It is a wonderfully progressive company—one with a service organization extending throughout the country, at the disposal of storage battery users, and it is the desire of the company to consult with and help any one who uses storage batteries for any purpose.

Western Electric Retail Store at Seattle

The recent opening of a retail store in Seattle's retail district is an indication of the growth of the Western Electric Company's system of retail stores originated to take care of the needs of individual customers. The new store is at 907 First avenue, a location convenient to city trade and handles all manner of electrical appliances and supplies collected to appeal to the needs of business man and householder. This line includes batteries, interphones, vacuum cleaners, lamps, motors, generators, wire and conduit.

The management of the store is in the hands of W. O. Preston who was formerly associated with the



The Seattle Store.

Seattle distributing house as house salesman. The retail store organization is under the direct supervision of H. D. Brainard the new sales manager of the Seattle house. Mr. Brainard until recently was assistant sales manager at Dallas.

Other important changes in the executive forces

have been the appointments of J. I. Colwell, formerly general credit manager, as manager of the Seattle house and of J. F. Ryan, formerly a member of the Seattle sales force, to be sales manager at Portland, reporting to the Seattle sales manager.

Copper Clad Wire Litigation Dismissed

Litigation in regard to "copper-clad" wire which has been contending in the United States Court in Pittsburgh for the past two years between Duplex Metals Company, complainant, and the Standard Underground Cable Company, defendant, was virtually decided June 25 when the case came before the court on motion made by complainant to dismiss the bill in respect to patent infringement. The bill as originally filed charged infringement of the patent and infringement of a trade mark. The motion made by the complainant was to dismiss without prejudice; that is to say, a dismissal leaving the complainant in a position to renew the suit at its pleasure. The motion was opposed, defendant contesting that the bill should be dismissed in this regard and a dismissal should be on the merits of the question. The court so ordered, the order reading:

Complainant having admitted that defendant's product referred to in the proofs herein does not infringe the Monnot patent in suit No. 893932, it is ordered adjudged and decreed that the bill of complainant herein, in so far as it is based on alleged infringement of said patent be, and the same hereby is dismissed on the ground that defendants have not infringed said patent.

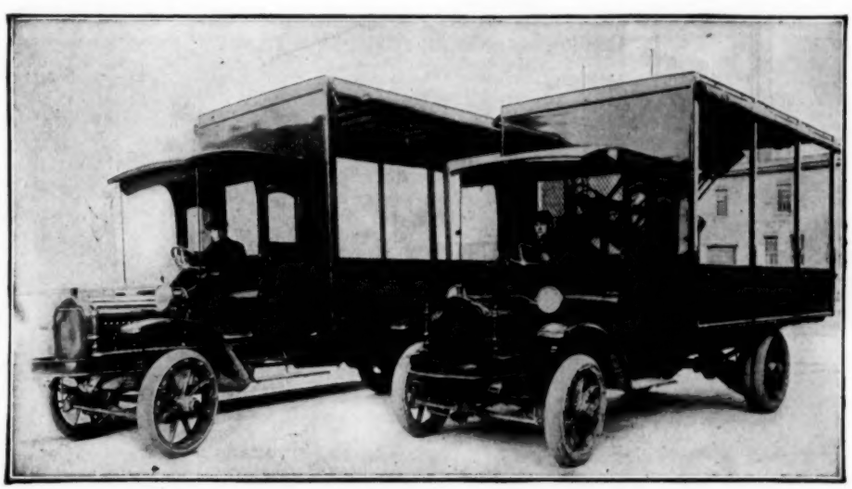
The order of the court directs that the complainant pay the costs. The only portion of the suit not thus disposed of is in regard to the right to use the trade name "Copper Clad" and which is expected to go to a hearing in the early fall.

Hawthorne Factory Adopts Motor Trucks

In a manufacturing plant as enormous as the Hawthorne works of the Western Electric Company, the problem of transporting material from one department to another in the least possible time becomes a serious one. The old-fashioned hand trucks and horse-drawn wagons have proved inadequate to the tremendous demands made upon them at Hawthorne, and the past year has seen them supplanted by motor vehicles.

Auto-trucks have been adopted as a means of transporting material between the different shops, and from the shops to the warehouse building of the general merchandise department. Before the adoption of these trucks, transfers of material were made in cars and wagons, both methods leaving the company dependent upon others for results. It is now possible to make a delivery from one section to another within one hour after request is made to the receiving and transfer department.

The White trucks have a capacity of three tons each, and are expected to be in service for at least ten years. The cost of maintenance is considerably less than the expense incurred by employing the former method. The illustration shows the trucks ready for business.



White Auto Trucks Adopted by the Company for Use at Hawthorne.

Joker in Missouri Utilities Act

Mayor Jost and other members of the city administration of Kansas City have found that a joker was slipped into the law creating the Missouri state public utilities commission.

The commission has not the power to require an interchangeable service between telephone companies in any city of the state.

The law creating and providing the powers of the commission clearly withholds this power from the commission.

The section of the law containing the joker reads:

When the commission, after a hearing had upon its own motion or upon complaint, shall find that a physical connection can reasonably be made between the lines of two or more telephone corporations or two or more telegraph corporations whose lines can be made to form a continuous line of connection by the construction and maintenance of suitable connections for the transfer of messages or conversations, and that public convenience and necessity will be subserved thereby, or shall find that two or more telegraph or telephone corporations have failed to establish joint rates, tolls or charges ought to be established, the commission may, by its order, require that such connection be made, *except where the purpose of such connection is primarily to secure the transmission of local messages or conversations between points within the same city or town*, and the conversations be transmitted and messages transferred over such connection under such rules and regulations as the commission may establish and prescribe through lines and joint rates, tolls and charges to be made and to be used, observed and in force in the future.

New Neptune and Triton lists covering a complete range from 11-cent to 25-cent base are being sent out by the Atlantic Insulated Wire & Cable Company. Neptune brand represents extra high grade insulation and Triton brand high grade intermediate insulation. The company sends also its Dolphin booklet covering commercial new code wires and cables.

A mailing folder showing 43 designs of glass insulators has just been sent us by the Brookfield Glass Company, New York City. Many of the designs are new. The folder will appeal to anyone who uses insulators. A free copy will be mailed on request.

The Service Association Meets

The Telephone Service Association held a meeting July 29 in its offices at 39 South La Salle street, Chicago. President J. W. Callahan, who occupied the chair, tendered his resignation on account of his expected retirement from the telephone business.

The discussion of the meeting centered around the proposed incorporation of the association under a state charter, and means of financing the work of the body. Frank L. Eldridge, general manager of the association, received many encomiums on his enthusiastic and loyal conduct of its affairs, and it was the general opinion of the meeting that this work and the strong moral support extended to the association throughout the independent field, should be productive of better financal support.

Committees were appointed by the chair to audit the books of the association and to study and report on plans for increasing its income.

The manager's report was very interesting, showing that the work of the association had been welcomed with open arms wherever it had been explained to independent telephone men. The book of operating rules, issued by the association, has been adopted as standard by many independent companies, and the by-laws of the association are indorsed by a number of the largest operators. Mr. Eldridge attended the recent meeting of the Western Pennsylvania Independent Telephone Association, and disposed of a larger number of the rule books than he had with him. This is only an example of the uniformly interested hearing which has been given the Service Association's representative.

At the afternoon session of the meeting R. L. Barry was elected president, Walter J. Uhl, treasurer, and Frank L. Eldridge, secretary and manager. A permanent finance committee was also appointed to canvass the states considered as offering the best material for the association, and bring in new members.

J. W. Coffey, of the Coffey System and Audit Company, Indianapolis, will install a system of accounting for the association.

Brevities of the Business

PERSONAL NOTES.

A. Noble, manager for the British Columbia Telephone Company at Port Moody, has been appointed police magistrate for that newly incorporated city. He has acted as justice of the peace there for two years.

H. C. Bramley has been made manager for the Dallas exchange of the Southwestern Telegraph and Telephone Company at Dallas, Tex. Under the arrangement Mr. Bramley will report direct to Mr. Baker and in his capacity as manager will assume direct jurisdiction in this city over the general business affairs of the organization he represents. Mr. Bramley, since 1909, has served as chief clerk to the general superintendent of traffic and previous to that time he was in the employ of the Western Electric Company, which manufactures and installs telephone equipment.

John D. McLeod, 70 years old, for many years head of the Wisconsin Telephone Company, died the early part of July, at Romeo, Mich. Death came after a short illness. Mr. McLeod is survived by his wife and two children. He returned to Romeo, his old home, where he owned property, after retiring from business in Milwaukee in 1909. He was buried there. Mr. McLeod was a resident of Milwaukee for forty years or more and was widely known among business men of the state.

Warren S. Funk, district manager of the New State Telephone Company at Sioux Falls, S. D., leaves his post the first of August to accept an executive position high in the commercial department of the Tri-State Telephone Company headquarters at Minneapolis. He has been with the local exchange for a period of seven years.

A. J. Adams has assumed his duties as manager for the Farmers' Mutual Telephone Company at Clarinda, Ia. Mr. Adams held a similar position at Pattonsburg, Mo., before coming to Clarinda.

A. D. Graham, for six years manager of the Mountain States Telegraph and Telephone Company in Albuquerque, N. M., has resigned. He is succeeded by J. B. Reynolds of Santa Fe. Mr. Graham will devote all of his time to other interests.

L. D. Brainard has been appointed manager of the Home Telephone Company at Dunkirk, N. Y., to succeed George H. Bernard, who has been transferred to the division commercial manager's department in Buffalo.

Bernard M. Mitchell, for eight years in the employ of the New York Telephone Company as acting tax agent for New York state for the Friendship Telephone Company, has been transferred to New York City to take charge of the tax department of the Western Union Telegraph Company.

G. T. Jones has been made traffic chief of the Joliet district of the Chicago Telephone Company. It is a new position created in this district, and it is expected to greatly increase the efficiency of the company through the district. Mr. Jones comes from Chicago, where he has been chief inspector of the service for the past 15 years.

W. R. Cook, division plant superintendent of the Bell Telephone Company for Lynchburg, Va., has been transferred to the Richmond office.

ELECTIONS.

At the annual meeting of the Mt. Pleasant Telephone Company, Iowa, the following directors were re-elected to serve the coming year: Dr. A. O. Pitcher, F. B. Montgomery, J. M. Green, Charles A. Gregg and C. S. Smith. The following officers were re-elected at a meeting of the directors: President, Dr. A. O. Pitcher; vice-president, J. M. Green; secretary, Charles A. Gregg; treasurer, Fred von Hon.

A meeting of representatives of sixteen telephone companies in Missouri was held at Sedalia to organize the Missouri State Telephone Association, which will have for its chief object better and more adequate service. Cape Girardeau, Macon, Maryville, Mansfield, Ava, Appleton City, Clinton, Willow Springs, Cameron, Bevier, Hopkins, La Platte, Boonville, Warrensburg, California, Windsor, Calhoun, Warsaw, Guthrie, Otterville, Smithton, Clarksburg and Cole Camp were represented. The temporary organization was effected by the election of Houck McHenry of Jefferson City, president, and Edward A. Hook of Appleton City, secretary. Arrangements were made for holding a meeting here August 21 and 22 to effect a permanent organization.

At a meeting of the Gleason Rural Telephone Company, Tennessee, held recently, W. R. Hawks was elected president and J. P. M. Deck was elected secretary. Two years ago Dr. J. E. Goldsby was elected president and at that time the company was in debt $300. Through his judicious and economical supervision the indebtedness has been paid off and the sum of $150 turned over to the new president. The system has been rebuilt and is now in good condition.

Four new directors were elected to the board of the Cleveland Telephone Company at the annual meeting and seven were re-elected, making the board eleven instead of nine members. E. A. Reed of Columbus, general manager of the company; Alonzo Burt of Chicago, vice-president; E. E. Jackson, also of Chicago, and U. N. Bethell of New York are the new members. John Sherwin, Frank Hickox, A. B. Hough, S. H. Tolles, P. Yensen, B. E. Sunny and Theodore N. Vail were re-elected. N. O. Stone's death created one vacancy. Philip Dexter and L. G. Richardson are the other retiring directors. Officers were elected as follows: President, B. E. Sunny; vice-president, Alonzo Burt; secretary, W. I. Mizner; assistant secretary, G. M. Hubbard; treasurer, C. E. Mosley; general auditor, B. S. Garvey.

The following were elected directors of the Nicollet County Telephone and Telegraph Company, Minnesota, for the ensuing year: M. B. Johnson, C. W. Carpenter, H. J. Essler, St. Peter; John Clark, Cleveland; Andrew Anderson, Winthrop; Andrew Nelson, Gaylord; Henry Knipple, Gibbon; C. C. Nelson.

Directors and officers of the Rock County Telephone Com-

pany were re-elected to their respective positions at the meeting of the stockholders and directors at Janesville, Wis. A semi-annual dividend of three and one-half per cent was declared. The directors re-elected were: Dr. F. B. Farnsworth, J. L. Bostwick, H. D. Murdock, I. F. Connors and Richard Valentine. The officers re-elected were Dr. F. B. Farnsworth, president; J. L. Bostwick, vice-president; H. D. Murdock, treasurer, and Richard Valentine, secretary and general manager.

NEWS FROM THE FIELD.

ARKANSAS.

Boone County Telephone Company, Little Rock; capital stock, $25,000. Incorporators, Troy Pace, J. H. Fowler and others.

The Southwestern Telegraph and Telephone Company is erecting a $100,000 building at Hot Springs and will spend another $100,000 in putting all its wires underground. The new building will be equipped with facilities to handle 5,000 subscribers. The present capacity is for 2,100. The outfit here will be the most expensive and complete used and owned by the company in any city the size of Hot Springs.

CALIFORNIA.

The United States Long Distance Telephone Company, Santa Monica, which was burned out of its quarters in the Decatur Hotel building last September, losing switchboard and all equipment, has "cut in" a new and much improved board in the First National Bank building at Marine street and Trolleyway.

COLORADO.

Work will start soon on a $40,000 addition to the building of the Mountain States Telephone and Telegraph Company at 120 East Kiowa street, Colorado Springs.

GEORGIA.

Preliminary to the erection of a modern office building and exchange the Southern Bell Telephone and Telegraph Company has purchased enough ground on Drayton street and Congress lane, Savannah, to give the company a lot that is 90 by 90 feet.

The Middle Georgia Telephone Company of Macon has been granted a charter by Secretary of State Phil Cook. The new company has an authorized capital stock of $25,000. The incorporators are A. Faucett and H. M. Fleetwood of Macon, J. P. Peacock of Cochran, M. C. Arnold of Danville and H. F. Griffin, Jr., of Jeffersonville.

IDAHO.

Articles of incorporation for the Crescent-Southwick Co-operative Telephone Company at Lewiston have been filed with the county recorder.

That the southern Idaho telephone field is to be invaded by an independent telephone corporation operating separately from that of the Mountain States Telephone & Telegraph Company, is indicated by the articles of incorporation of the Idaho Southern Telephone Company. The capital stock is $50,000 and the principal place of business is to be Bruneau.

ILLINOIS.

One stroke of lightning recently cost the DeKalb County Telephone Company, at Syracuse, something in the neighborhood of $15,000. The entire switchboard was burned out.

The White County Telephone Company of Carmi has become the property of the Commercial Telephone and Telegraph Company of Robinson, Ill. It is understood the purchasing company paid $35,000 for the local plant, which is one of the best in southern Illinois. William R. Stokes will be manager for the company.

By arranging for the expenditure of $22,000 for more switchboard and equipment to be installed in the addition to its present exchange building now under construction, the Central Union Telephone Company has raised the total appropriation for improvements in Moline to nearly $200,000. Before the close of this year the last dollar will have been spent and Moline telephone users will then be served by a system that has been thoroughly reorganized and rearranged and almost wholly reconstructed during a period of 16 months.

The capital of the Lexington Home Telephone Company was increased from $20,000 to $50,000.

The East Peoria telephone system is to have a material improvement over the present system of communication with Peoria. This was announced by E. T. Teece of the Interstate Telephone Company when he received permission from the war department to lay a cable across the bed of the Illinois river to the neighboring city. This cable will take the place of the wires which cross over the McKinley bridge. The overhead wires have caused much trouble in the past because of their proximity to wires carrying a high voltage, and the improvement is expected to counteract this difficulty. The laying of the cable will necessitate an expenditure of $20,000.

Three-quarters of a million dollars has been appropriated for the trunk line extensions and exchange buildings in Chicago. The new 3-story colonial "Stewart" exchange at the corner of Seventy-sixth street and Eggleston avenue will cost $84,000. It will be of the highest type of fireproof construction throughout, insuring patrons against interruptions to service and safeguarding the lives of employes. The Stewart exchange will relieve the Wentworth exchange and provision has been made for two other exchanges. The new "Beverly" exchange building in Ninety-third street near Prospect avenue will ultimately contain three exchanges with a capacity for twenty-five thousand telephones. This is the twenty-eighth exchange of the telephone company in Chicago.

Dix Telephone Company, Elliott; capital stock increased from $6,000 to $12,000.

INDIANA.

The Cumberland Telephone and Telegraph Company has bought the Luce and Union Townships Home Telephone Company, in Spencer county, southeast of Petersburg, at receiver's sale, paying $28,000.

IOWA.

The general and local offices of the Cedar Rapids and Marion Telephone Company, at 318 and 320 South Second street, Cedar Rapids, have been moved to the large room on the first floor of the Exchange building.

Large improvements in the equipment of the Sioux City Telephone Company, involving an expenditure of over $100,000, will be made this summer. Work will start immediately, according to President Howard S. Baker. The company proposes to lay six miles of underground conduit. Several carloads of material have arrived and the contract for digging the six miles of ditches has been let.

KANSAS.

The Peoples' Home Telephone Company of Lansing filed an application with the public utilities commission for permission to sell to the Lansing Telephone Company. Also the Lansing Telephone Company asked for permission to issue $1,500 in notes to cover the cost of buying out the Home company.

Hoyt now has but one telephone system. The farmers' line, or Mutual telephone, as it was called, has merged with the Independent company. The Mutual company includes four party lines and about twenty-five subscribers among the farmers northeast of Hoyt. They will continue to own their own lines and telephones, but will pay to connect with the Independent company.

KENTUCKY.

The Summerville Telephone Company, Summerville; capital, $600. Incorporators, R. L. Morris, J. B. Estes, Dave Milby and Jake Milby.

MARYLAND.

An amendment to the charter of the Chesapeake & Potomac Telephone Company of Baltimore City was filed in the record office, increasing the capitalization of the company from $10,000 to $10,000,000. Application will shortly be made to the Public Service Commission for permission to issue the new stock. As the present capitalization of $10,000 of the company has already been issued as common stock and paid for in cash, the additional capital authorized is $9,990,000, which will be divided into 199,800 shares, with a par value of $50. The document was signed by F. H. Bethell, president of the company; Charles H. Carter, Thomas J. Shryock, W. N. Bethell and M. H. Buehler.

MASSACHUSETTS.

The Blake Signal and Manufacturing Company of Boston, E. J. Burke, president, has changed its address from 245 Summer street to 251 Causeway street.

MICHIGAN.

The Tuscola Farmers' Telephone Company of Millington has capitalized with $10,000 and incorporators, C. W. McNeal, J. D. Austin, Ira J. Hossler, Roy Haines, W. L. Brooks, Archie Gillis and Abner Strong. This company will purchase the exchange and property of the Arbela Mutual Company.

The Ishpeming system will be practically rebuilt, but the Negaunee plant is in fairly good condition, especially the switchboard, which was purchased a few years ago when the central station was moved from the Cleveland-Cliffs Iron Company's land office to the Neely block.

The state treasury has been enriched $149,178.30 by payment to the state of back taxes and interest due from the Citizens' Telephone Companies of Grand Rapids, Battle Creek and Jackson. This will swell the primary school apportionment, as the money will revert to the primary school fund. The Citizens' of

Grand Rapids paid $84,411.01 of the amount, Jackson Citizens' $9,597.88, and Battle Creek Citizens' $55,169.41.

The Farmers' Telephone and the Bell telephone exchanges are to be united at Eaton Rapids.

Plans for the erection of the new one-story brick north exchange building of the Citizens Telephone Company, which will be located on Caledonia street, and just one block from the present quarters, in the Kent State Bank building, Grand Rapids, have been received, and work of construction is to begin at once. The switchboard will have a capacity for 2,000 telephones and will provide ample service for some time to come in that growing section.

About $18,000 will be spent by the Michigan State Telephone Company in Detroit in combining lines and creating new facilities in the Walnut office district, an attractive residential section. It will be necessary to lay about a mile of underground conduit with a capacity for four large cables to serve 5,000 telephones.

MINNESOTA.

Bemidji is to have a strictly up-to-date automatic flash telephone service with the office and equipment of the company housed in a modern two-story brick building, according to plans submitted.

The Northwestern Telephone Company has already commenced additional extensive improvements of its system in Stillwater and the immediate surroundings.

MISSISSIPPI.

Booneville Home Telephone Company, Booneville, Prentiss county; shares valued at $10 each. W. H. Kier, Terry Rees, and others.

MISSOURI.

Boone County Telephone Company; capital stock, $25,000. Incorporators, Troy Pace, J. H. Fowler and others.

NEBRASKA.

The new exchange and office building of the Lincoln Telephone and Telegraph Company is completed. The first floor is devoted to store rooms, while the second and third floors are used by the company. On the second floor are the offices of the president, secretary, treasurer, district plant chief, commercial department, general manager and auditing department. On the third floor is the traffic department, superintendent of plant department, engineering department and operating department. The building is 100 feet square and is three stories high. It cost $80,000. On the third floor is a shower bath for the linemen. The building is fireproof and is constructed of brick, stone, concrete and steel.

The Stanton Telephone Company desires to increase its capital stock from $15,000 to $25,000 and will make a formal application to that effect before the railway commission. An official of the company who was at the capitol represented that the company has property worth $23,000, although it is capitalized for only $15,000.

NEW YORK.

The Federal Telephone and Cable Company has completed plans for cable extensions in Lancaster which will cost about $25,000. The new work provides for a thorough overhauling of the cables of the Geneva Telephone Company and a large increase in cable capacity to take care of the present demands and future extensions of the company.

The New York Telephone Company announces that it has filed a new schedule of telephone rates for Utica, which will be effective August 1. These rates will be quoted after August to all applicants for service, but will not be effective for present subscribers until November 1.

OHIO.

Application was made by the Middletown Telephone Company to the State Public Service Commission for authority to issue $49,500 in common and $4,000 in preferred stock, the money to be used in rehabilitating the plant. This was seriously damaged in the March floods. The application was taken under advisement.

Both of the telephone plants at Lima are now owned by the Lima Telephone and Telegraph Company. A deed and bill of sale covering the entire property of the Central Union Telephone Company were passed to the Lima company.

The Coshocton Citizens Telephone Company has been given permission by the Public Service Commission to issue $375 of new stock and to issue and sell $17,000 six per cent notes to make enlargements. The company wanted to issue $10,575 of common stock, but the commission declined to permit that amount to be issued.

OKLAHOMA.

The Holland Springs Telephone Company, Fairview; capital, $1,000. Directors, W. D. Ross, S. E. Colby, J. E. Davison, S. C. Burlison, James McCraith, J. R. Thompson and Joe Thompson, all of Fairview.

PENNSYLVANIA.

The Interstate Telephone Company of Scranton has been given a 25-year franchise by the Hampshire village board. It allows for a rental charge of $2 for a business and $1.50 for a residence telephone per month.

Smithfield Rural Telephone Company, North Water Gap; capital, $5,000.

F. L. Hoover & Sons, Pomeroy Construction Company, F. W. Van Loon, and Charles McCaull Company, Philadelphia, are estimating on plans for alterations to the telephone exchanges for the Bell Telephone Company.

SOUTH DAKOTA.

The secretary of state chartered the New Era Farmers Telephone Company of Lucas. Incorporators, Michael Jones, Frank D. Faust, C. F. Deegan, of Lucas, and F. C. Brookings of Burke. Capital stock, $5,000.

The newly organized Garretson Cooperative Telephone Company, which is composed of farmers, has purchased the Garretson telephone system and will conduct it in future. The purchase also includes seven rural lines centering in Garretson.

Farmers in the region east, west and north of Carthage have organized a cooperative company and will build a farmers' telephone line through those sections. The line will have twenty-two miles of wire and will accommodate a large number of farmers.

TENNESSEE.

A new telephone line connected with the People's Telephone and Telegraph Company west of Knoxville, near the Anderson county line, has been put in operation.

For $5,500 the Cumberland Telephone & Telegraph Company at Columbia, purchased from Anderson Bros. & Foster, Dobbins & Ewing and Walter P. Wooldridge the vacant lot in the rear of the stores occupied by those firms and fronting on South Garden street. It is understood that on this lot the telephone company will at an early date begin the erection of a handsome building for the offices and plant and exchange of the company. It will also be the home of the Western Union Telegraph Company.

The semi-annual statement of the Citizens' Telephone Company of Dickson has been issued by the secretary and treasurer, G. S. Pentecost, which shows this institution in a prosperous condition, having a surplus of $595.78 and undivided profits of $1,025.30. An 8 per cent dividend was declared and the stockholders are well pleased.

The Johnson County Telephone Company, Johnson county; capital, $4,000. Incorporators, L. M. McQueen, C. T. Lipscomb, D. H. Donnelly, C. C. Nonnelly, M. A. Donnelly.

WEST VIRGINIA.

That the Consolidated Telephone Company of Wheeling, recent purchaser of the National Telephone Corporation properties in this state, contemplates making marked physical improvement to the property is evidenced by the fact that the new company has just been granted permission to increase its capital stock to $3,000,000. The original capital was $500,000. It is the plan, it is understood, to issue 30,000 shares of common stock, with a par value of $100 each.

WISCONSIN.

Contract for the construction of the Rock County Telephone Company's new building at Janesville was let to W. R. Hayes, who will start work as promptly as possible. It is hoped to have the structure completed in about three months' time. The building will be fifty-two feet deep and thirty feet wide.

To repair the ravages caused by the severe storms of last winter, the Wisconsin Telephone Company at Milwaukee has appropriated $50,000, which will be divided as follows: $20,000 to the Eau Claire district, $15,000 to the Appleton district, $12,000 to the Madison district, and $8,000 to the Milwaukee district.

A. C. Gallagher, manager for the Wisconsin Telephone Company at Oshkosh, has been notified from headquarters that in the 1913 apportionment of the improvement fund for the system in the state of Wisconsin an expenditure of $14,870 has been authorized for the local exchange building. That does not include the building and repairing of lines or any work outside of the exchange proper. Other work will be done under another apportionment.

WYOMING.

The Garland Telephone Company is building another telephone line to Penrose. This line runs due south from Garland to the Osher's ranch across the river, thence into Penrose. The Penrose line will then be cut in two divisions to provide better service.